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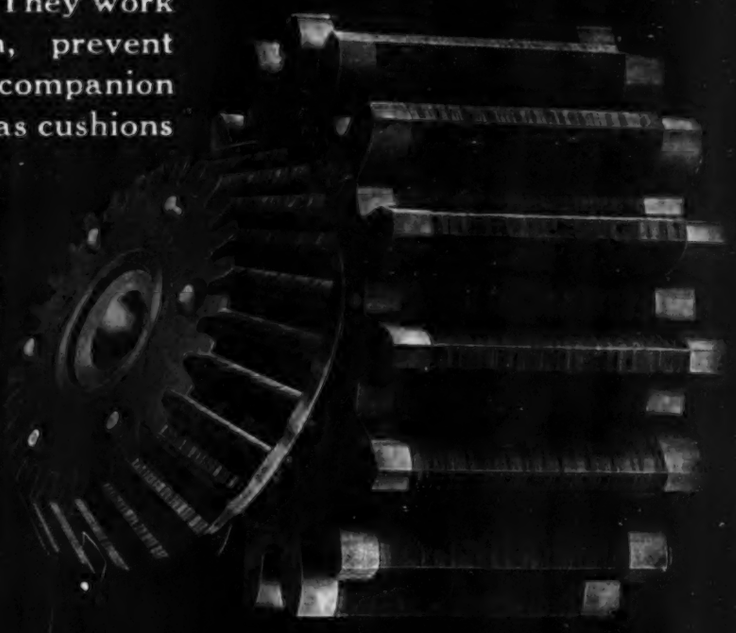

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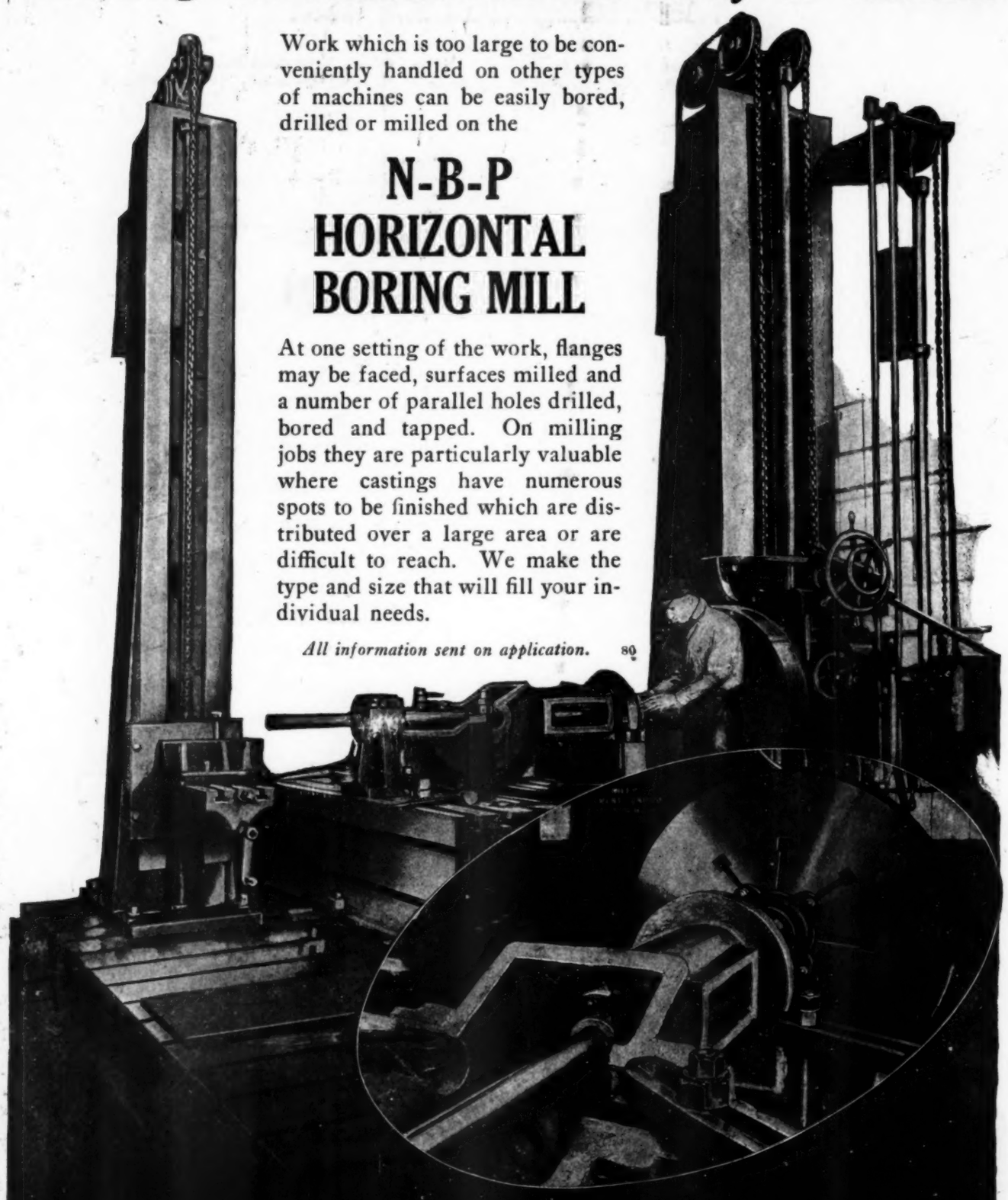

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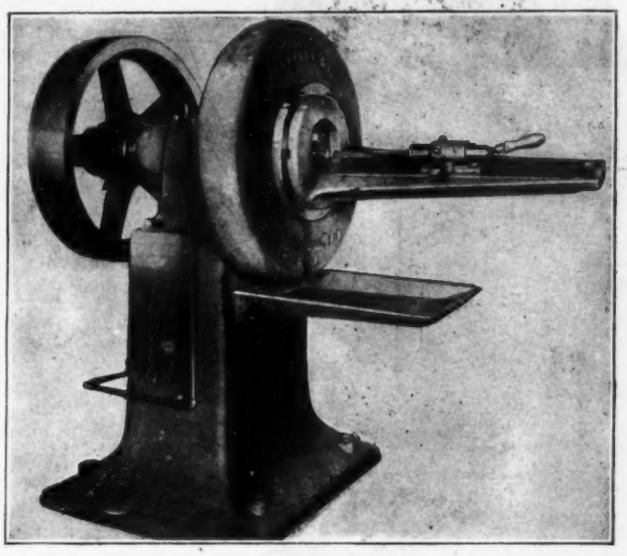


The Rotary Swaging Machines and Their Work

BY E. A. SUVERKROP

The art of machine swaging is not nearly so well known as it should be when we consider that a number of the articles in universal use are the product of the swaging machine. Many articles, straight, tapered or pointed, or combinations of these, besides many other forms either solid or hollow, can be accurately and cheaply made in this machine.

THE term "swaging" has come to be rather loosely applied to entirely different methods of forming metal parts. In the one case (the method employed for tapering the stock for the legs of certain well-known toolmakers' dividers and calipers) the material is passed into a pair of rapidly revolving dies which are opened and closed approximately 3000 times per minute so that their influence on the work is more that of a vibrating pressure rather than a series of blows or hammer strokes. In the writer's opinion this method constitutes true swaging for it is without doubt the development of the process of swaging as practiced by the blacksmith. The fact that the metal in many instances is worked cold should not alter the fact that this is true swaging.

The other method to which the term "swaging" is applied would more correctly be termed "coining." Examples of this work have been shown in the *American Machinist* from time to time.

The Langelier Manufacturing Co., Providence, R. I., has for many years been building machines for performing the operation of swaging as set forth in the first paragraph of this article.

Three types of these machines and many sizes are now built by this concern besides which they manufacture a hammering machine which is very similar in principle to the swaging machine.

Before showing the product, brief descriptions of the various types of machines will enable the reader to grasp the subject more intelligently.

In the headpiece is shown a No. 4 fixed roll machine with the simplest form of mechanical work holder.

The main frame of the machine is a semi-steel casting which is bored for the spindle. Fig. 2 will give an idea of the internal mechanism. The main frame *A* at the front of the machine is bored for the reception of the spindle head *B*. It will be noted that the spindle head is somewhat smaller than the hole in the main frame. Eight blind holes *C* are bored as shown. These are for the reception of hardened-steel rollers *D* which are a running fit in them. The spindle head *B* has a bearing in the frame at *E* behind the rollers *D* and the stem *F* of the spindle also takes a bearing in the body of the machine. The flywheel is secured direct to the rear end of the diameter *F* of the spindle.

The spindle head *B* is slotted for the reception of the hammer blocks *G* and *H*. These blocks are made of high-grade tool steel carefully hardened. At their outer ends they are bored for the rolls *I* and *J*. These rolls are also of tool steel carefully hardened. The inner ends of the hammer blocks are slotted for the reception

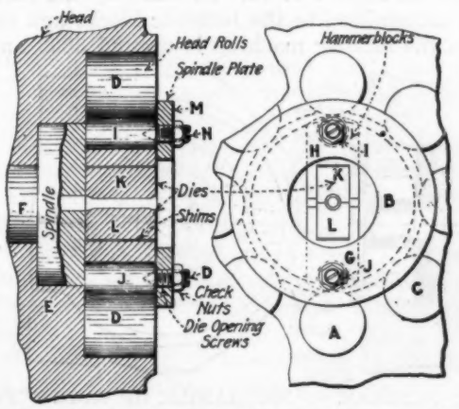


FIG. 2. DIAGRAM OF FIXED ROLL MECHANISM

of the swaging dies *K* and *L*. These dies are a sliding fit in the slots in the hammer blocks, and are of course hardened and tempered. A spindle plate *M* is secured to the front end of the spindle. The object of this plate is to retain the various parts and to provide means for limiting the opening of the swaging dies during the inoperative or expanded period of their cycle of operations. This latter is attained in the following manner: The rolls *I* and *J* are a snug turning fit in the hammer blocks *G* and *H*. The forward end of each of the rolls *I* and *J* is provided with a concentric female cone. The spindle plate *M* is provided with two cone-pointed ad-

justing screws *N* and *O* with locknuts to bind them when set. Obviously if the screws *N* and *O* are withdrawn the rolls *I* and *J* will have greater freedom of movement radially than if the conical ends of these screws nearly seat in the rolls as shown in the illustration.

Adjustment of the hammer blocks to regulate the closed position of the dies is by means of shims of tempered sheet steel which are interposed between the hammer block and the swaging dies as indicated.

The operation of the machine is as follows: When the spindle *B* is caused to rotate, centrifugal force throws the hammer blocks away from the center thus opening the dies, but the eight head rolls *D* project toward the center beyond the path of the hammer block rolls *I* and *J*. Therefore as the rolls *I* and *J* pass each diametrically opposite pair of rolls *D* they are forced toward the center of the machine and carry the hammer blocks and swaging dies with them. Immediately on passing the head rolls *D*, centrifugal force throws the hammer blocks and dies apart again. The speeds of the spindles of the various sizes of machines vary from 350 or more for the smaller to 190 for the larger. The number of head rolls in the machines varies from 8 to 12. In this way the number of strokes transmitted to the hammer blocks and swaging dies in the smaller machine is around 3000 and in the larger, 2200 per min. The type of machine shown is used on both hot and cold stock, solid or hollow.

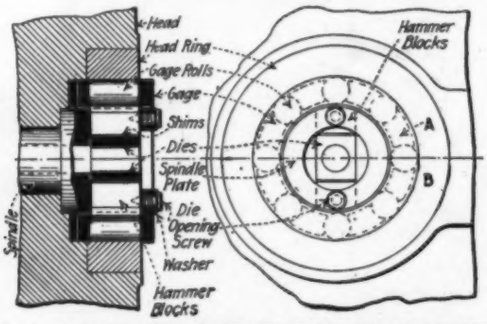


FIG. 4. DIAGRAM OF MECHANISM OF CAGE-TYPE MACHINE

In this work as in all die work, experience is of prime importance. The man with the greatest experience can usually best judge as to what can or cannot be done, but with many shapes it is impossible to say before trial whether the work can or can not be made by this process. A notable example of this is a return bend which had been turned down as impossible by a number of men skilled in swaging but which today is being made in quantities in equipment specially designed by Mr. Langelier.

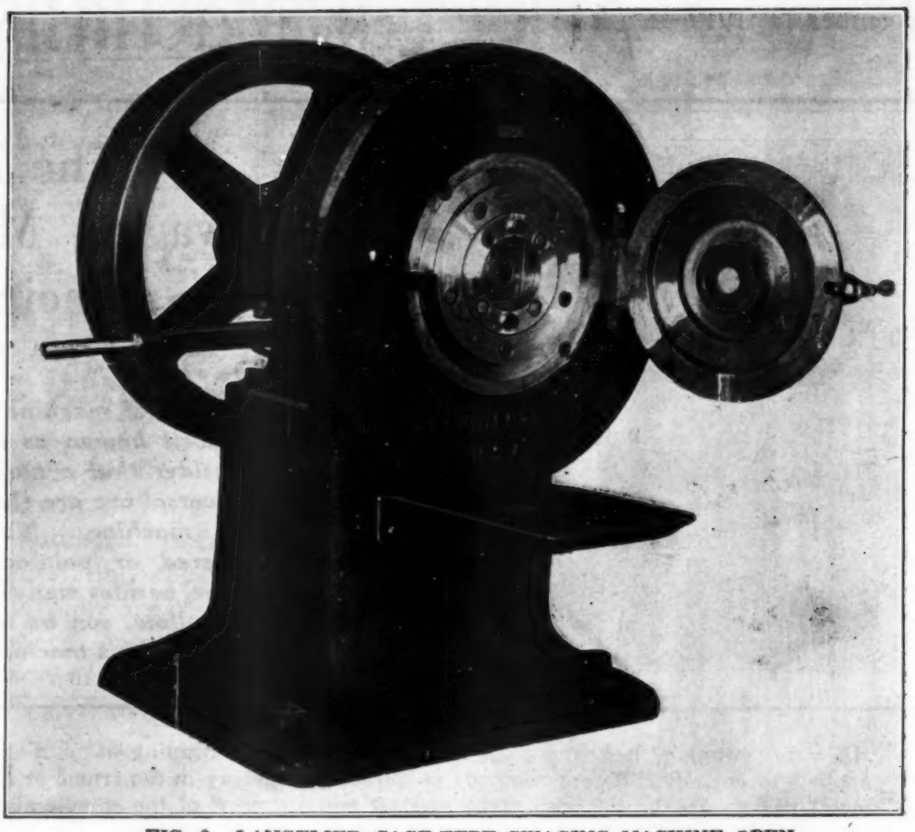


FIG. 3. LANGELIER CAGE-TYPE SWAGING MACHINE OPEN

There are many factors which determine whether or not a piece of work may be accomplished by this process; the hardness or ductility of the stock, the length to be tapered, and the profile are all elements which determine what can be done.

The second type of swaging machine is shown in Fig. 3. The spindle of this machine is practically the same as that of the fixed roll machine but interposed between the frame of the machine and the spindle head is a revolving cage of rollers as shown at *A* in Fig. 4. The frame is bored for the hardened-steel head ring *B* which is a running fit for the roller cage *A*. The other features of the mechanism are practically identical with the fixed roll machine. However, there is considerable difference in their action. In the fixed roll machine the blow is almost instantaneous while in this one the cage *A* rotates slowly in the same direction as the spindle. This action is imparted to it by the hammer block rolls as they contact with the rolls in the cage, resulting in an intermittent rotation of the cage. This retards the blow of the hammer blocks, resulting in more of a squeeze than a blow. But with this machine there is a tendency to twist the work due to the slow release of the dies. These slow blows are best adapted to solid work of large diameter, as it gives the stock more time to flow.

The third type of machine is the so-called hammering machine which is virtually a high-speed trip hammer. This is shown in Fig. 5.

In this machine the upper die is fixed in the reciprocating head while the lower one is fixed in a holder which is raised or lowered by means of a wedge operated by a foot lever. Stops are provided for limiting the movements of the die in each direction.

Much of the work done on the hammering machine

must be rotated during the hammering operation. This is accomplished by means of an automatic fixture attached to the hammering machine and belt driven from a pulley on the spindle of the machine. One of these fixtures is shown attached to the hammering machine in Fig. 6.

Mention was made at the beginning of this article of certain well-known caliper and divider legs made by this process. In Fig. 7 are shown several sizes of these with the time necessary to produce them on a Langelier swaging machine. The stock is carbon-steel wire and the work is done cold.

In Fig. 8 a number of articles have been grouped. Each article bears a reference letter and the figures to the left of each piece signify the operations.

At *A*, Fig. 8, is shown a hot-swaged file blank. The stock is regular high-carbon file steel. The hot swaging improves the structure of the steel and the product is much more accurate and uniform than that made by the usual process under a trip hammer. The production is about 10 per minute.

At *B* is shown the five operations necessary to produce a corkscrew blank by cold swaging. Operation 1 is produced at the rate of six per minute; 2 at the rate of five per minute; 3 at the rate of four per minute; 4 at the rate of four per minute and 5, at five per minute.

At *C* is shown a valve for an automobile engine. The blank, to the left, has a turned stem. Where a high degree of accuracy is required the stems are best swaged in two operations, the first bringing the stem to within a few thousandths of finished size and the second completing the work. When performed in this way on the size of valve shown the first operation is turned out at the rate of six per minute and the second at the rate of three per minute.

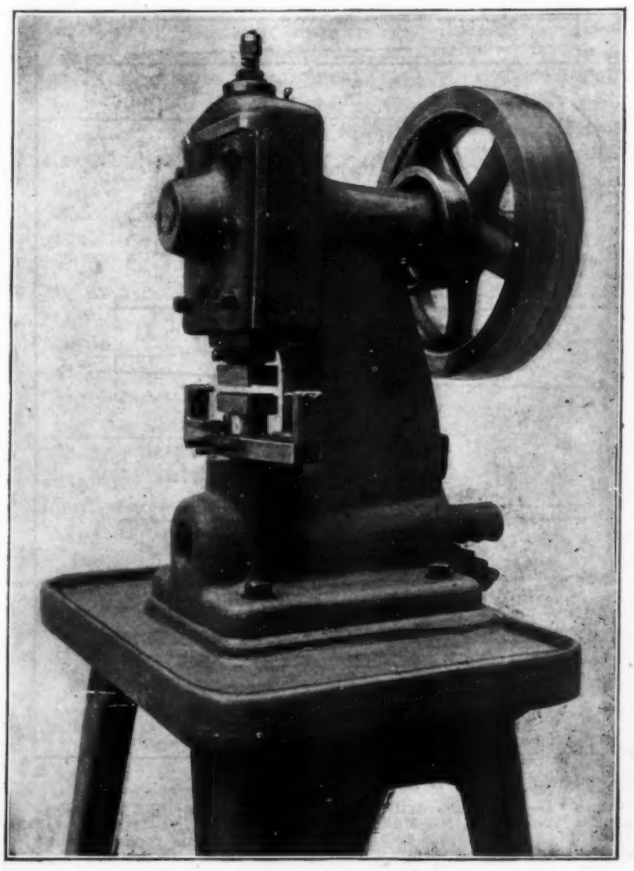


FIG. 5. LANGELIER HAMMERING MACHINE

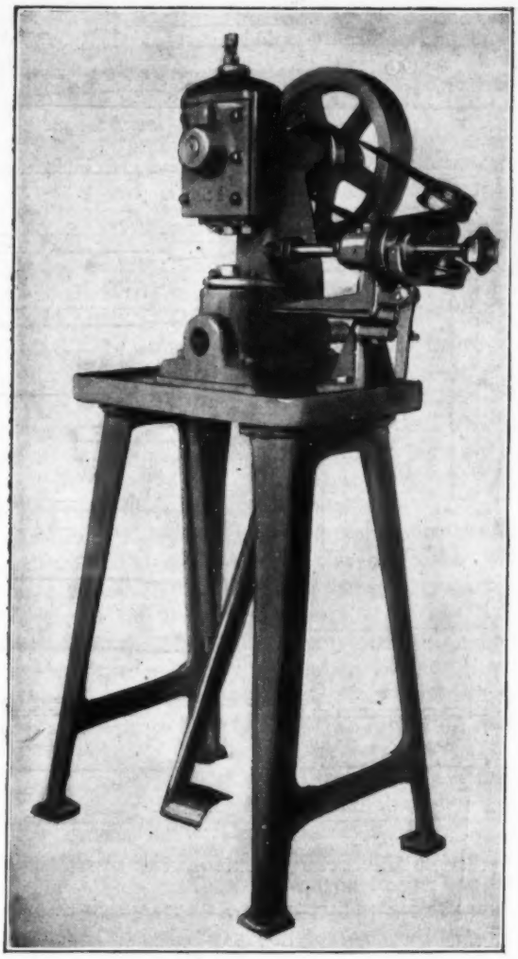


FIG. 6. LANGELIER HAMMERING MACHINE WITH AUTOMATIC ATTACHMENT

At *D* is shown a bit stock drill and a bell hanger's drill. These are cold swaged to size at the rate of four to five per minute.

The first two operations on the part shown at *E*, Fig. 8, are each produced on the swaging machine at the rate of six per minute. Operations 3 and 4, the forming of the head, are performed on a hammering machine at the rate of six per minute each.

The piece shown at *F* is made of steel wire and the production is six, seven and eight per minute for operations 1, 2 and 3.

The piece shown at *G* is soft steel. The blank is made on a screw machine. The piece is finished in three operations at the rate of three pieces per minute per operation.

The piece shown at *H* is made from steel wire. The first operation is tapering done on a swaging machine. A thread is then rolled on the end marked *a*. The ball is screwed on and the work finished in the hammering machine. The first operation is performed at the rate of 12 per minute and the second at the rate of five per minute.

At *I* are shown the two operations necessary to swage a tool-steel spindle used in cotton-spinning machinery. The first operation is produced at the rate of seven per minute and the final operation at the rate of 12 per minute.

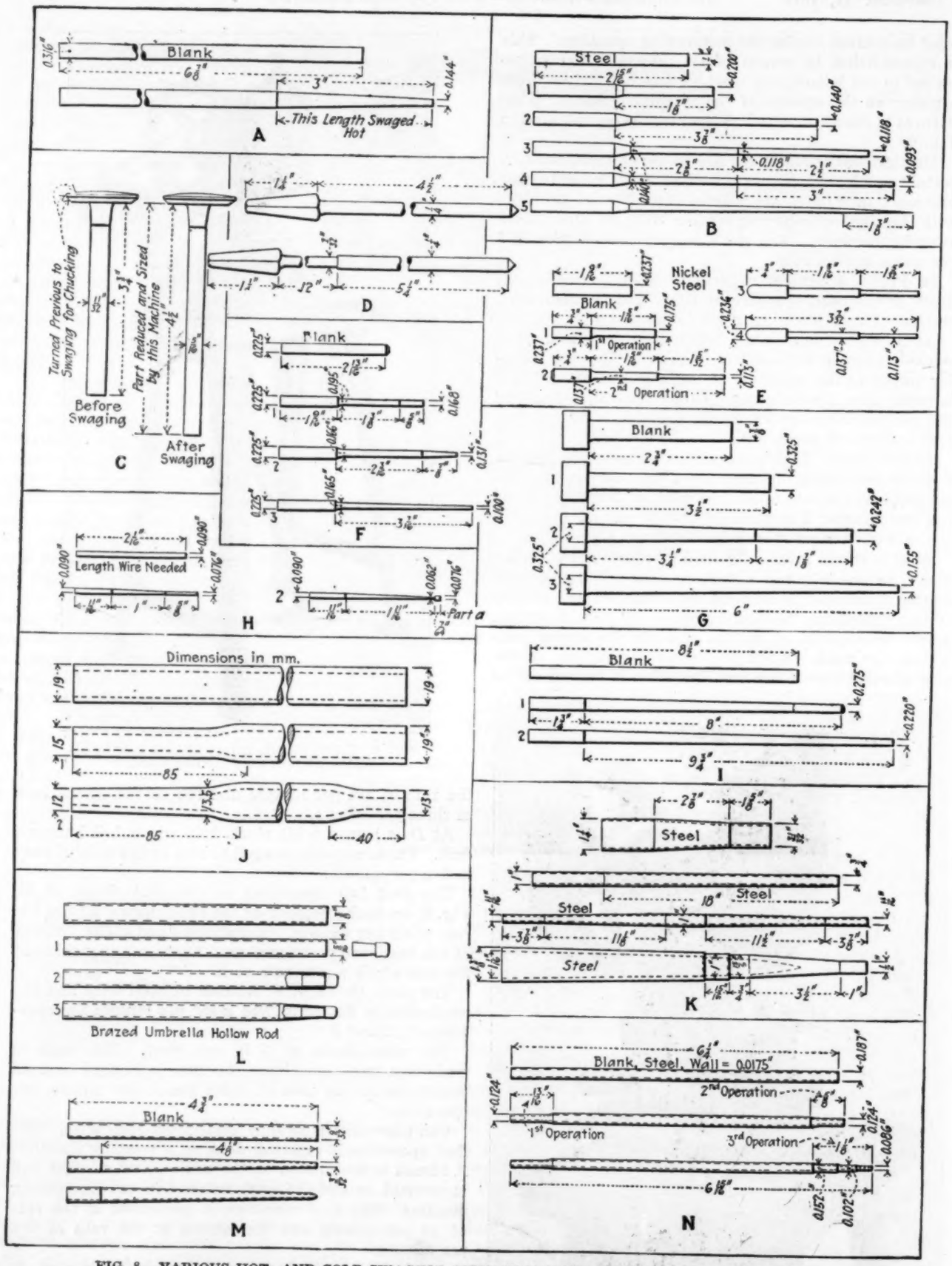
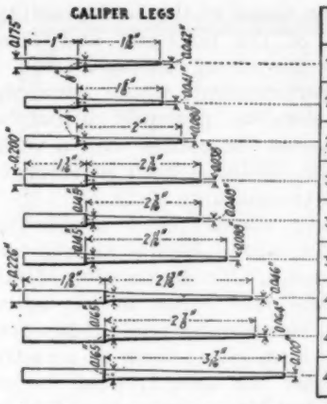


FIG. 8. VARIOUS HOT- AND COLD-SWAGING OPERATIONS ON TUBULAR AND SOLID STOCK

A—File bank. *B*—Corkscrew blank. *C*—Valve for automobile engine. *D*—Bit-stock drill and a bell hanger's drill. *E*—Operations 1 and 2 performed on swaging machine; 3 and 4 on a hammering machine. *F*—Made from steel wire. *G*—Made from soft steel. *H*—Made from steel wire. *I*—Two operations in forging a spinning-machine spindle. *J* to *M*—Various forms of tube swaging. *K*—Four examples of tubular work. *L*—Three operations on the end of a brazed tubular umbrella rod. *M*—Two operations on a tubular penholder. *N*—Example of swaging thin tubes.



NAME	NO. OF OPERTNS	OUTPUT
2" Divider	2	1st Operation = 8 per Min. 2nd " = 6 " "
2" Inside Caliper	2	1st Operation = 8 per Min. 2nd " = 6 " "
2" Outside Caliper	2	1st Operation = 8 per Min. 2nd " = 6 " "
3" Divider	2	1st Operation = 7 per Min. 2nd " = 5 " "
3" Inside Caliper	2	1st Operation = 7 per Min. 2nd " = 5 " "
3" Outside Caliper	2	1st Operation = 7 per Min. 2nd " = 5 " "
4" Divider	3	1st Operation = 6 per Min. 2nd " = 5 " " 3rd " = 4 " "
4" Inside Caliper	3	1st Operation = 6 per Min. 2nd " = 5 " " 3rd " = 4 " "
4" Outside Caliper	3	1st Operation = 6 per Min. 2nd " = 5 " " 3rd " = 4 " "

FIG. 7. SWAGING OPERATIONS ON CALIPER AND DIVIDER LEGS

Tubing is just as successfully swaged as solid metal but it must of course be handled intelligently. The samples shown from *J* to *M* inclusive are of various forms of tube swaging.

The seamless steel tube snown at *J* is produced at the rate of from three or four pieces per minute. The long end requires two operations to one for the short end. A similar piece, not shown in the illustration, was made of thick brass tubing but the hole was to be the same diameter throughout while the outside diameter was reduced at each end. This was accomplished by passing

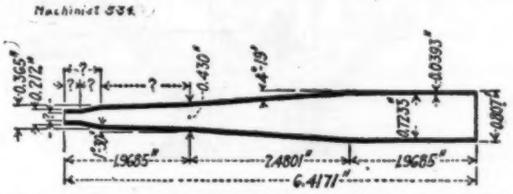


FIG. 9. DIFFICULT PIECE OF TUBULAR SWAGING

the tubing over a mandrel of the same diameter as the hole, and between the dies.

At *K* are shown four examples of tubular work. For long tapers the spindle of the swaging machine is hollow, the dies are long and special guides are employed so that the tapers are concentric with the straight part of the tubing. The upper sample shows a swaging operation on tubing, for automobiles, done at one pass. The second example is the front fork of a bicycle which is swaged in three operations. The third example is a bicycle handlebar, each end of which is tapered in three operations. The bottom sample is an axle for a light carriage which is swaged cold in one operation. In the finished product the small end is practically solid.

At *L* are shown three operations on the end of a tubular, brazed umbrella rod. The brazed tube is first passed into sizing dies to make it the desired size, and round. In this operation the reduction varies from $\frac{1}{32}$ to $\frac{1}{16}$ in. The turned slug is then inserted and the end passed into tapered swaging dies which close the tube around the slug. The production is at the rate of five per minute per operation.

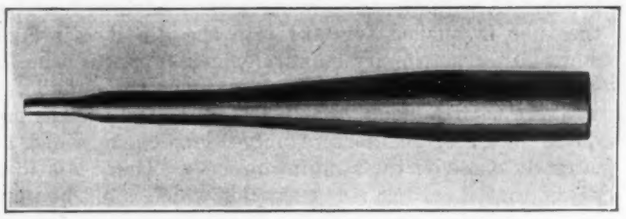


FIG. 11. THE FINISH-SWAGED TUBE

At *M* are shown the two swaging operations on a tubular penholder. The stock used is only 0.010 in. thick It is therefore necessary, in order to prevent crimping and splitting, to swage the tube over a tapered arbor. The time on this job is about four per operation per minute. The use of an arbor on a much more difficult job is shown in Figs. 9 and 10.

Another example of swaging thin tubes is shown at *N* in Fig. 8. The speed here is five per minute for tapering each end in the first two operations, and four per minute for the third operation.

The line cut, Fig. 9, shows a difficult piece of taper swaging, and in Fig. 10 is shown the swaging machine equipped with a special holder for producing it. The tubing is comparatively large in diameter and of thin wall. Obviously, if this tube were fed direct into the die without any support it would wrinkle and crack.

This is entirely overcome by handling the work in the following manner: The mandrel *A*, Fig. 10, is shaped the same as the inside of the finished tube shown in Fig. 11. This mandrel is secured to the bar *B*, Fig. 10, which slides in the bracket *C*. The stop *D* entering the notch *E* locates the mandrel correctly in the dies *F*, and secures it against end movement. The sliding bracket *G* seats the rear end of the straight piece of tube after it is slipped over the mandrel *A*.

The mandrel is then moved forward to its place. The

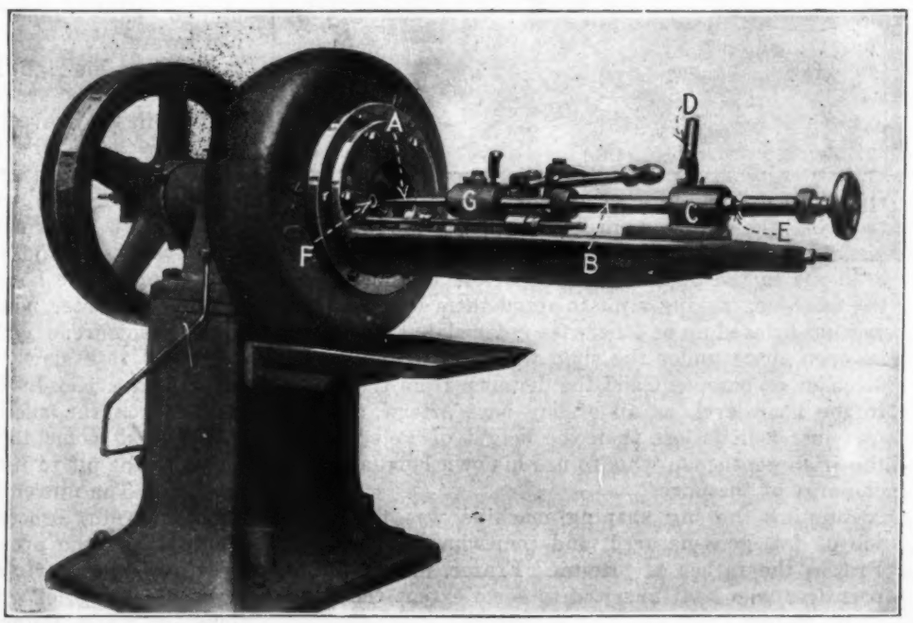


FIG. 10. LANGELIER SWAGING MACHINE SPECIALLY ARRANGED TO PRODUCE THE PIECE SHOWN IN FIG. 11

bracket *G*, with the tube in it, is then advanced, and as the tube is pushed forward into the die it is swaged down on the stationary mandrel which supports it on the inside while the swaging dies close it on the outside.

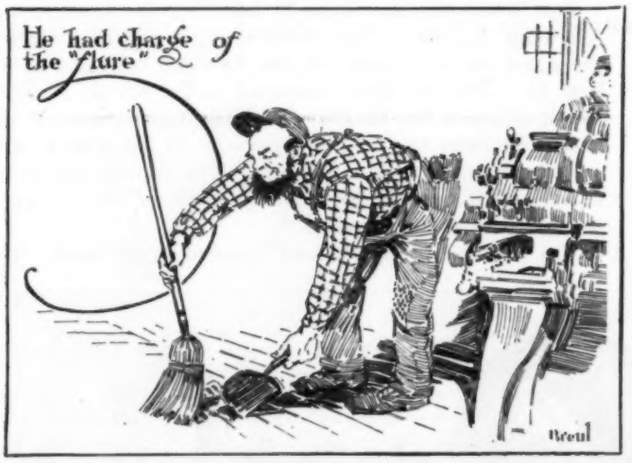
There is little doubt that many forms, which are produced by other methods, can be more cheaply and accurately made by the swaging process. There is also no doubt that there are many articles which could be made by the swaging process that are not made at all because the possibilities of the swaging process are known to so few designers and manufacturers.

Pipe Dreams of a Tramp Machinist—How Peter Found Tom

BY GLENN QUHARITY

In the Brookdell shops there was a machine known to the trade at that time as a traverse head shaper. While such machines are still in use in locomotive shops and similar establishments, they are not so common in ordinary shops, and for the benefit of many mechanics who never saw one I will say that they were like an ordinary shaping machine, only wider—very much wider—and the knee was adjustable up and down but had no traverse movement. The ram, however, was mounted on a sliding head, the ram having all the movements of the usual shaping-machine ram and capable besides of being traversed either by hand or power clear across the width of the machine.

One of the principal uses to which this machine was put was the planing of the under surfaces of the up-



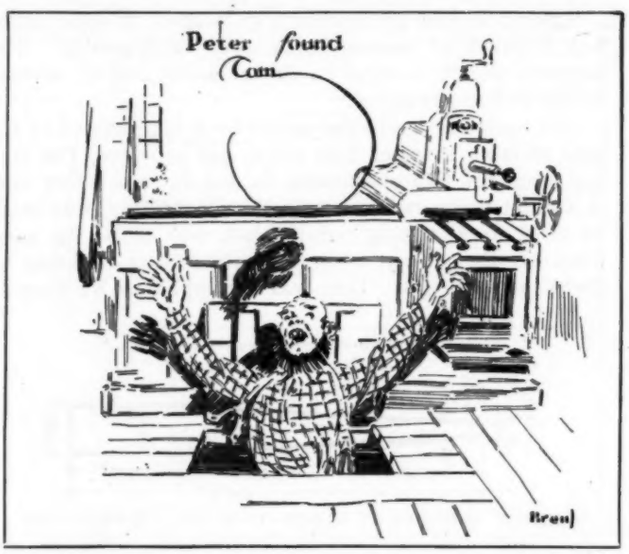
rights for drop-presses, or stamps. As it was necessary to stand these pieces up endwise, and as they were anywhere from four to six feet long, a trap door had been cut in the floor of the shop close to the front of the machine, making a pit to stand them in. The "pit" was not bricked up or otherwise finished, but was simply an open space under the shop which at that point had no cellar or basement and the distance from the ground to the floor level, as all of our boys afterward knew, was just a little less than the height of Peter Brown, the Irish gentleman who, to use his own language, "had cha-arge of the flure."

Running the big shaping machine was the special job of fat, good-natured, and somewhat bibulous Tom Frazer, the father of "Heinie" Frazer, one of our apprentices who had inherited to some extent the failing of his parent.

One warm spring morning the shaping machine was idle. Orders were piled up ahead of the work; castings were piled up in front of the machine; and Tom's overalls were piled up on the pile of castings.

Mr. Williams, our superintendent, whose knowledge of occultism was considerable, promptly dispatched Heinie to the saloon down on the corner with a verbal message that, had not Mr. Williams been in error for once, would have started the machine P. D. Q.

An hour later the only visible result of Heinie's quest was an empty spot where Heinie should have been. Mr. Williams then sent Peter Brown after Heinie. Peter, who knew that the real object of his search was Tom and not Heinie, consistently took off his overalls in front of Tom's machine, piling them on a casting which lay on the floor near the open trap of the pit. (Apparently, Tom hadn't put the cover on the night before, which was a flagrant disregard of orders.)

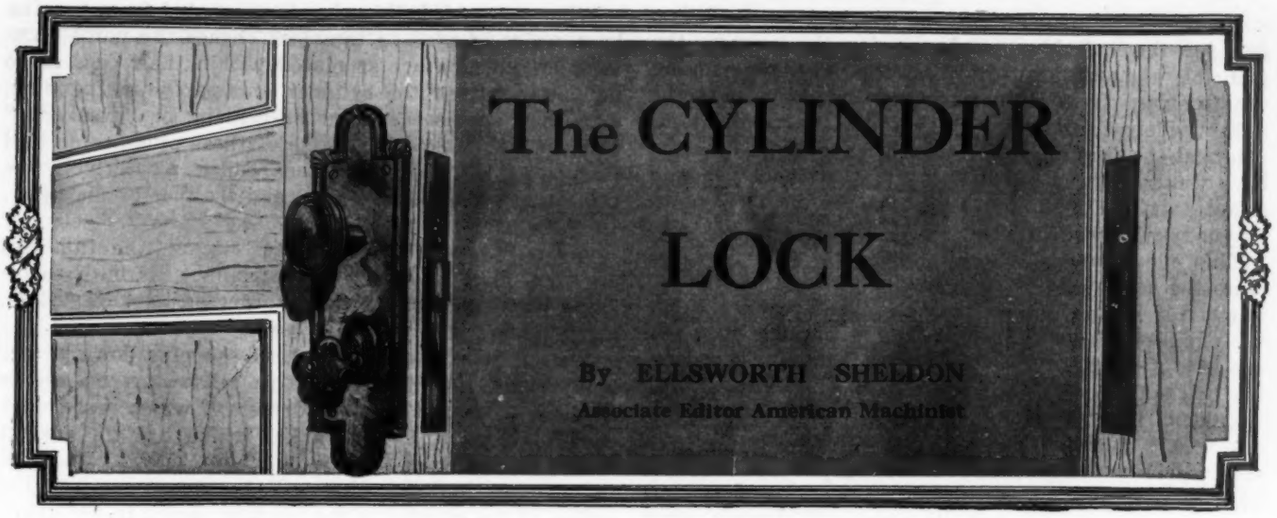


Peter marched solemnly in the supposed direction of the culprits, and after an unconscionably long time marched even more solemnly back again. He had not found Tom but he *had* found Heinie; Heinie had asked him to "have somp'n" and Peter had; in fact, he had had several.

Peter got his right leg into the left leg of his overalls and was wildly struggling to stand upright on one foot while he waved his other leg around in a vain endeavor to find the rest of his overalls to put it into when he got too near the opening in the floor and, in spite of a frantic scramble to avoid the catastrophe, fell in up to his armpits.

There was a wild yell from Peter; there was a wild yell from all the boys, each of whom had had at least one eye on Peter, and there was a wild, though somewhat sepulchrous yell from the subterranean regions, as Peter rose slowly and majestically without visible effort, like a jack-in-the-box with a pneumatic retarding device, from the hole in the floor. Peter had found Tom.

Tom had come in early that morning and climbed down in the pit to fix up some blocking for his work to rest on. The unwonted warmth and quiet, the potency of his morning bracer (2.75 stuff had not then been invented) and the proximity of a pile of old burlap had been too much for old Tom. He had fallen asleep and was dreaming of himself as master-mechanic of a brewery when Peter unceremoniously landed "in his midst."



The CYLINDER LOCK

By ELLSWORTH SHELDON
Associate Editor American Machinist

III. Master-Keying System

While there were "master keys" before the coming of the pin-tumbler lock, their scope was very limited, and the flexibility of the system made possible by the advent of the latter was undreamed of. Master keys under the old order could only take the form of "skeleton" keys, in which the skeleton, or master, was of the same contour as the individual key in so far as its bearing on the lock parts was concerned. It was exactly what its name implies, a key with the unnecessary parts filed away; anybody with a file and a key to any one of a series of locks, could make a master that would pass the entire series.

BEFORE the days of the pin tumbler a lock, especially one placed to guard valuable property or the entrance to premises of importance, was a rather formidable piece of machinery. Though, perhaps, no more complicated than their successors, they were much heavier and more clumsy, without affording in the least degree greater security.

The heavy bolts that were deemed necessary to secure the massive doors of an earlier day required keys proportionately heavy and strong to move them, and the guarding mechanism (tumblers) also had to be strong, as it was opposed to the movement of the bolt instead of being interposed between key and bolt.

In the cylinder lock the guarding devices are interposed between the key and the bolt and no turning moment can reach the bolt until they are destroyed.

The Tumblers

The tumblers were flat pieces of metal with a peculiar-shaped opening fitting over a projection extending from the side of the bolt. The number of tumblers ranged from one to five, according to the degree of elaboration considered desirable by the manufacturer. The opening in each tumbler acted as a latch or stop to prevent the bolt from being thrown back until the tumbler was lifted against the pressure of its spring, and the shape of the opening was such that it was necessary to lift the tumbler to a certain position before it would release the bolt. Lifting a tumbler a little too high would stop the bolt as effectually as not lifting it quite high enough, and as this limitation was comparatively narrow and each tumbler in a set necessitated a different setting from any of its fellows, it required a considerable degree of accuracy in the shaping of the key bit to enable it to pass the lock.

The Wards

There were two systems of master-keying used with the old style locks, the one generally used having but one keyhole and having projections called "wards" on the inside of the lock case that prevented the key from turning unless the latter was filed away at the point that would otherwise strike the ward. The wards were of two kinds, or rather were located in two places. "Side wards" were irregularities in the contour of the keyhole and interposed a barrier to the insertion of any key that did not have a corresponding slot across the face of the key bit. "Wheel wards" projected from the inner surface of the lock case and prevented a key from turning unless it was warded to match.

Side wards did not faze the lockpicker very much, as with a warding file he could remove the projections in a few minutes. Wheel wards were equally futile, as the metal had only to be removed from the key.

The filed-away portion of the key bit was also called the ward, and in a series of about 24 locks, in which the tumblers were all alike, the wards would occupy a different place in each lock case. A key filed to match the ward of one lock would obviously not pass another lock, but it is equally obvious that if the otherwise useless material at the edge of the bit were *all* filed away, the result (literally a skeleton key) would pass all the locks, and anybody with a key and file could become the possessor of a master key.

Another form of master-keyed lock had two keyholes, one for the individual, and one for the master, the principle of operation being that the two keys, moving the tumblers from different points of contact, might differ widely in contour and yet set the tumblers to identical positions. Superimposition of the master keys was rarely extended above two as indeed it was unnecessary to go higher since the practical range to any one series was 24 locks.

This, more readily than anything, will serve to illustrate the advantage of the cylinder lock. The possible number of changes in a series was 24, the practical number of master keys, one; that is, a key would open but one lock of a series, or it would open them all. The number of changes possible in each series of a cylinder lock is 100,000 or more, and six steps to the master-key system are commonly used. To cite a possible example, two adjoining hotels may have each a thousand locks, with their individual, suite, floor, master, grand master, and emergency keys, yet, though both houses were secured with locks of the same series, not a key of one house would move a lock in the other. When I add that 98 similar hotels could be added to the group before exhausting the series without affecting the integrity of the individual locks, some idea of the flexibility of the system may be obtained.

Two-Cylinder Locks

Cylinder locks are sometimes made with two cylinders, which will of course double the possibilities of master-keying, but it must be remembered that the greater the number of *different* keys that will pass one lock the less is the security guaranteed by it. This system is not commonly used on exposed locks; that is, locks the outside of which may be reached by anybody; but is rather limited to intercommunicating doors that are themselves ordinarily protected by other doors.

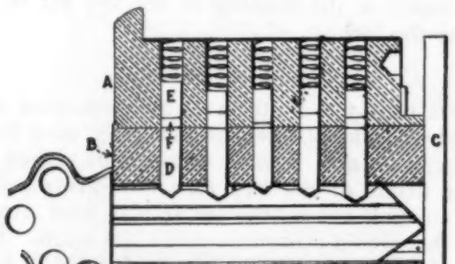


FIG. 12. SECTION OF A LOCK SHOWING TUMBLERS

This was an early method of increasing the range of the master-keying system, and though still used to some extent, has been largely superseded by later designs of single-cylinder locks.

The line drawing, Fig. 12, while not intended to represent actual cylinder-lock construction, is presented to show the positions and explain the functions of the various parts. In this cut *A* is the cylinder, which, when placed in the lock case, is firmly fastened thereto and has no further movement in relation to it. *B* is the plug which is free to turn within the cylinder, but is held against end movement by the shoulder at the outer end, and the cam *C*, which is screwed and doweled to the inner end. Turning the plug by means of the key causes this cam to bear upon levers contained within the lock case and through them to throw back the bolt or latch.

When assembled, this plug is prevented from turning by a series of pins or tumblers (hence the name "pin-tumbler") which are so placed within their cells as to lie partly within the cylinder and partly in the plug, extending across the point of bearing or "break-line" between the two parts. Some of these pins are divided into three (or more) sections called respectively the tumbler (*D*), the driver (*E*), and the master disk (*F*). In the commoner form of lock there are five cells for tumblers, though in some cases not all the tumblers are "set up." In better locks and in locks built to include the "emergency" key in the master-key system, six tumblers are generally used.

The coil springs serve to hold the pins down to the lowest point in their respective cells when no key is in the lock, so that it is the drivers *E* which rest across the break-line. If, now, a key which has the correct bitting and section—which "fits" the lock—is inserted in the key-slot, the pins will be raised against the action of the springs to the position shown in the drawing, where the break-line between the tumblers and the master disks coincides with the periphery of the plug. In this position the plug is free to turn in either direction, for as soon as the pins are turned out of line the upper sections will be supported by the surface of the plug and offer no resistance to the turning movement.

As the plug is turned the cam is brought to bear upon the lever of the bolt mechanism which is contained in the lock case, thus establishing direct mechanical connection between the latter and the key. After the plug has been turned slightly out of line with the holes in the cylinder, the key cannot be removed from the slot for the reason that the upper ends of the tumblers, abutting against the inner wall of the cylinder, cannot lift to allow the high points of the key bitting to pass under them.

The Master Disks

The introduction of the master disk *F* is to provide for the operation of the lock by a series of master keys. It is obvious that the mechanism, as shown in Fig. 12, could be operated by two totally different keys, one as seen in the drawing and the other with its bitting so arranged as to bring the upper division—the junction of *F* and *E*—of the line of tumblers in line with the periphery of the plug.

Further study will show that any key that will bring any *combination* of these divisions to the proper place will pass the lock. As a matter of fact, with a lock made as shown in the cut, we would find, by the law of permutation, that it could be passed by no less than $1 \times 2 \times 3 \times 4 \times 5 = 120$ different keys. As stated above, however, this drawing does *not* represent actual lock construction. Master disks are supplied in but two or three of the tumblers (according to the number of master keys desired) and the practical superimposition of master keys is limited to about six in any one series; otherwise, it would not be possible to avoid interference of master keys between different series.

Flexibility of the System

To illustrate the flexibility of the master-key system, let us assume a hotel with 1000 guest rooms. This would require 1000 individual keys, each fitting its own lock and no other, and further would require at least one-half that number in addition to pass the intercommunicating doors when the rooms were let en suite. Now, if a guest desired three connecting rooms, he

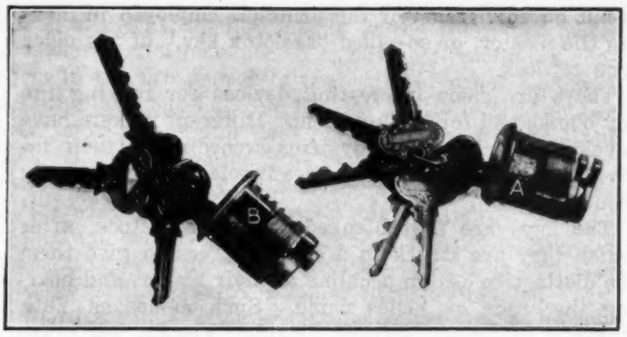


FIG. 13. CYLINDERS INCORPORATING THE EMERGENCY MECHANISM

would require five keys: one for each of the corridor doors, and one each for the inner doors connecting the rooms. Instead of five keys the clerk will hand him one key which will pass the five locks of his suite, but will not unlock the intercommunicating doors on either side. If later he desires to increase his suite to five rooms the clerk will substitute a key that not only will pass the five locks, but will be readily accepted by the remaining locks that refused the former key.

In order to avoid the necessity of carrying a large bunch of keys, each house servant is given one key which will open any room to which she has the right of entry, upon the floor to which she is assigned, but will not pass a lock upon any other floor.

The house superintendent has one key which will open all guest rooms and rooms used in the house service wherever they may be located; but there may be rooms to which no official has the right of entry and the locks upon these doors will move only for the proprietor's, or grand-master, key which is the open sesame for any lock in the house.

The Emergency Key

There is still another key, known as the emergency key, which is even more potent than the grand-master key. On the inside of each guest-room door in a hotel fitted with the highest type of cylinder lock (this is also true of offices, apartment houses, etc.), there is a knob which, when turned, locks the door against all keys up to and including the grand-master key. With the lock in this position the guest is safe from the intrusion of even the hotel proprietor.

But guests sometimes die in their rooms, either naturally or by suicide; a fire or explosion may render them incapable of action; guests have even been known to leave their rooms by means of the window and a rope in order to avoid tiresome conversation with the clerk in reference to certain financial matters. In cases of this kind the emergency key is brought out of its hiding place in the office safe and readily passes the lock that has refused all other keys. The emergency key is able to accomplish this result because it operates a special part of the lock mechanism that is there solely for that purpose, being inoperative under all normal conditions.

In Fig. 13 are two cylinders fitted with the emergency mechanism. It will be noticed that the one at *A* has two cams. The outer one of these cams is operated by all keys up to and including the grand master, which each lift five tumblers. The sixth tumbler remains stationary with the break-line between the tumbler and the driver at the point of junction between the plug and the sleeve to which the inner cam is secured. Fig. 14 shows, in section, the principle of this lock. *A* is the cylinder, *B* the plug, *C* and *D* the inner and outer cams respectively; *E* is the sleeve to which the cam *C* is attached, and *F* is a loose spacing collar; cam *D* is fastened directly to the plug *B*.

The sixth tumbler is shown with the driver resting across the break between sleeve and cylinder, locking these two parts together. The break-line of the sixth tumbler is normally at the break between the sleeve and the plug, and as the regular keys do not reach this tumbler it interposes no obstacle to the turning of the plug.

The emergency key, which is longer than all the others, lifts the sixth tumbler until the break-line corresponds to the junction between the sleeve and the cylinder wall. The sleeve is now locked by the sixth tumbler to the plug and turns with it. The bitting of the emergency key corresponds to that of the grand-master key, thus lifting the break-lines of the first five tumblers to a proper position (otherwise the plug would not turn) and therefore turns both cams. The inner cam bears upon a lever that has hitherto remained inoperative and through it throws back the bolt.

To avoid bringing the operating pressure upon the tumbler which now joins the sleeve to the plug, the sleeve has a small keyway into which the emergency key (being slightly longer than the others, as previously noted) enters, and the torsional strain is thus borne directly by the key.

In the cylinder at *B*, Fig. 13, practically the same result is accomplished by the round projection upon the back of the cam, this projection being raised by the emergency key to a position where it will contact with the extra lever of the lock.

The Selective Key

Further adaptation of the master-key system is made in what is called the "shut-out" system. A salesman arrives at a hotel with a line of valuable samples which he desires to display to prospective customers. Taking a room or suite of rooms, he arranges his samples to his satisfaction and departs to interview a customer. During his absence his valuable samples, but for the shut-

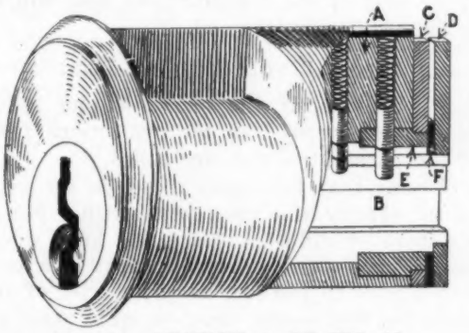


FIG. 14. SECTION *A*, OF FIG. 13

out system of locking, would be at the mercy of any house servant who had or could obtain the suite, floor, or master key. In such cases the salesman is given a shut-out key with which he locks his doors in such manner that nothing but the key that locked them and the emergency key will pass them.

This security is provided not by an extra lock, but by the mechanism that is a part of the regular lock, and further any desired number of locks may be ar-

ranged to operate in this manner by simply locking them with selective keys, each of course differing from all others and operating only its own particular lock or suite. There is no way of securing a door against the emergency key except by fastening it with other means than that provided by the lock.

Another Application of the Master Key

Another application of the master-keying system may be used by the business man who wants one key to open his house, his club, his office and perhaps his desk. His partner may have the same desire, and both may

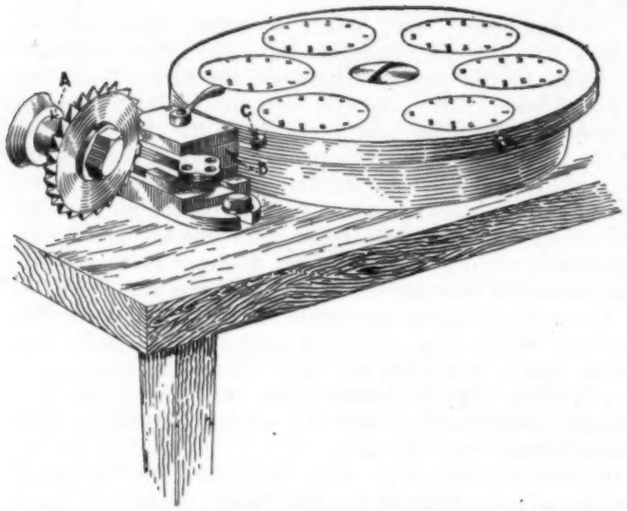


FIG. 15. PRINCIPLE OF THE KEY BITTING MACHINE

be accommodated through the flexibility of the master-key system.

The two keys will pass the same office door, possibly the same door at the club, but there their similarity ceases. Other keys to the office will not pass the door at the club, neither will the keys of other club members pass the office, nor will any of these other keys pass the private locks of either of the partners. If it is desired to add a new lock to the series and avoid the necessity for a separate key, the code number and letter of the key may be sent to the manufacturer who will set up the new cylinder to correspond.

"Warding" the Cylinder Lock

Further extension of the master-keying system is provided by the "wards," as the projections from the sides of the paracentric slot are called.

It is obvious that two locks could be set up to be operated by exactly the same key bitting, but if the key slots were of different shape the keys would not interchange. It follows, therefore, that if a series of key changes runs to 100,000, another series of 100,000, duplicating the first series, could be made proof against the keys of the first series by merely changing the form of the slot.

There are many forms of these slots with their corresponding key-sections; special sections sometimes being designed for large hotels or for business houses having extensive establishments in different cities, these special designs being reserved for the exclusive use of the customer for whom they were made. It is possible to make a key that will enter two, three, or even more, of these different slots by simply milling away portions of the metal to avoid the wards in the key-slot. This is but an application of the principle employed in making the master, or so-called "skeleton key," of the older type of lock.

There are some interesting devices for making the key blanks and for bitting them. Different makers have developed machines and systems according to their individual ideas, but the principles involved are practically identical.

The keys are first blanked from sheet stock, after which they are struck in a coining press to give them the distinctive design peculiar to their maker, and bearing the trade or series name. Such names as Yale, Russwin, Corbin, Sargent, Eagle, Vassar, etc., are familiar throughout the world wherever locks are used.

Some, but not all, makers use a code consisting of a combination of letters and figures in which the letters indicate the key section and the figures the bitting. Other makers use figures alone and still others only letters. The cylinder of a lock bears a corresponding symbol, and this symbol is all that the lockmaker needs to make a key to fit it.

Reputable lockmakers, however, will not fill promiscuous orders for duplicate keys. The order must come from someone of known standing, or be accompanied by indisputable evidence that the person ordering the key has the right to pass the corresponding lock.

The Key-Bitting Machine

Fig. 15 is an outline, showing the principle of the key-bitting machine. *A* is the arbor carrying a cutter, the profile of which is the same as one step of the key to be cut. *B* is a carrier which holds the key blanks and has a movement in two directions, one parallel to the length of the key, and one to and from the cutter. Both movements are automatic and one is so related to the other that the key takes one step (lengthwise) after each forward and back movement, so that when the cycle is finished the carrier goes back to its original position and the machine stops.

The key is moved forward against the cutter by the hardened-steel buttons *C*, the relative prominence of

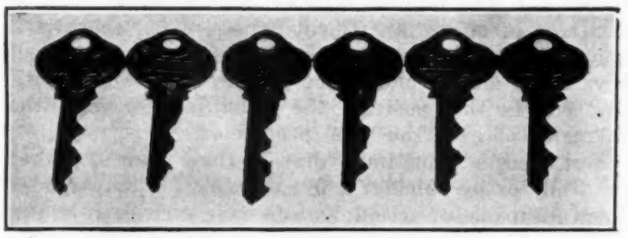


FIG. 16. SERIES OF KEYS FITTING ONE LOCK

which is determined by cams under the smaller dials. Each numbered position of one of these cams advances the position of its button 0.015 in., which is the variation allowed in the lock between one series and another. As the number of steps on each cam is 12, thus the total variation between the shallowest and the deepest cut is 0.180 in., or nearly $\frac{3}{16}$ in.

The operation of cutting a key is extremely simple. Suppose your key number J 41144 is lost, and you want another. The operator's order bears little besides that cabalistic message, and she (it is usually she) sets the dials successively, beginning with number 1, so that they read IV.I.I.IV.IV. She then sets a "J" blank in the carrier and trips a clutch; in twenty seconds your key is ready, and there is no question about its fitting

the lock. (This applies only to fitting their own locks. A maker cannot be expected to have his machinery conform in the *n*th degree to the codes of other makers.) As your key has but five figures, it fits a five-tumbler lock, and the operator does not bother to set the sixth dial, for though the machine makes this movement anyway, your key-blank is not long enough to reach the cutter when the carrier passes this position.

The number of combinations theoretically possible is the sixth power of 12 or 2,985,984, but as is the case relative to the possible number of superimposed keys, the entire range is never used, about 100,000 changes being given to a series.

The section of the key blank is produced by machines operating upon similar principles. Certain cutters or combinations of cutters occupy definite positions upon the arbor of the machine, and the blank is carried under these cutters in certain positions, being stepped sidewise very much as in the other machine it is stepped endwise.

Fig. 16 shows six keys, no two of which are alike, but all of which fit one lock. They are respectively individual, suite, floor, master, grand-master and emergency.

In view of the enormous number of cylinder locks in use, there must of course be some cases of exact duplication where an unauthorized and unsuspected key will pass a lock not intended for it, but the manufacturers keep a careful record of each lock series with its multitudinous key changes, keeping dangerous similarities as widely separated geographically as can be done, so that, while it is possible that there may be a key to your front door in the pocket of your neighbor around the block, it is very unlikely. Even though a duplicate of your key may be in the hands of a professional crook, the chances are a million to one that he doesn't suspect it, and trying to find a lock that his key fitted would give him less satisfaction than trying to open a safe without knowing the combination.

War Production Speed Aided by Oxy-Acetylene Cutting*

By R. R. Browning
Vice President, Oxweld Acetylene Co., Chicago, Ill.

Business men in this country knew early in 1916 that production of war material would have to be speeded up to meet the demands of the Allies. The demand for steel of all kinds to be used in shells, ships, guns, artillery, etc., became tremendous, with the logical result that scrap metal was required by the thousands of tons. The use of the oxy-acetylene cutting process in wrecking old boilers, ships, tanks, etc., for steel scrap, increased to such a point that portable outfits were carried to the most inaccessible places in country districts, the process applied, and charging-box steel scrap produced for shipment to the mills. Without the oxy-acetylene cutting process, the scrap market would have been in an absolute panic to supply the tremendous tonnage demand.

With the inauguration of submarine warfare by Germany, it became immediately apparent to the American shipbuilding industry that steel ships, without number, would be required. The oxy-acetylene cutting process was one of the first processes to be called upon to speed up production in old, as well as in new, shipyards. The development of the applications in the shipyards, occasioned by the demand for more ships, was a matter given special attention by the Welding Committee of the United States Emergency Fleet Corporation, by the American Bureau of Shipping, and by Lloyds. The result was the application of the process to such important work as the following: Cutting or trimming of plates and structural iron to shape; making manholes, portholes, patches, ventilator and funnel openings, stairway openings, mast openings and deadlights; trimming stem and sternposts; cutting frames and "between rib" plates; cutting shafting, pipes, chains, rivets and scrap.

In cutting holes in plates it had always been customary in shipyards to punch a large number of holes with a ½- or ¾-in. punch around the outline of the proposed hole. The central portion, or plate, was in this manner removed and the edge then trimmed by means of a chipping hammer. An average of 1½ hr. was required to make in this manner a 12-in. diameter porthole, whereas with an oxy-acetylene circular cutting torch and a simple attachment, the portholes were, during the war, and are now, completed in an average time of 5 min. each. This not only shows a considerable saving in time and cost in doing the work, but the finished porthole as made by the oxy-acetylene cutting process is better in appearance than that of the older process.

The process had been for years applied to the cutting of armor plate, but during the war the increased efficiency of heavy ordnance made it essential to increase the thickness of armor plate used on battleships and seacoast defences. The oxy-acetylene process took care of this increased cutting limit in many instances in the manufacture of new armor plate. As a result of the change of armor-plate construction made necessary by the war, Government proving grounds such as that conducted at Aberdeen, Md., were called upon to test, seemingly without limit, all kinds of armor plate. After this plate had been hit by several shells it was, of course, only suitable for scrap. The problem, however, was to reduce it to handling size so that it could be remelted. A specific example of this can be quoted from work done at the Pittsburgh Crucible Steel Co., Midland, Penn., where thousands of tons of this scrap armor plate, averaging 16 to 17½ in. in thickness, was cut by the oxy-acetylene process. Working cost showed the actual cutting of this material at the very low figure of $1\frac{3}{10}$c. per square inch and the wonderful speed of three lin.in. cut per minute. This speed is the more remarkable when one stops to consider the high percentage of chrome and nickel contained in armor plate.

Shortly after the United States took up arms against Germany, contracts were placed with numerous steel foundries throughout the country for castings to be used in the construction of naval and field guns. One of these castings, called the gun slide, is most difficult to manufacture. It has a trunnion or projection of metal on each side, which is very heavy compared to the walls of the casting, and in order to eliminate shrinkage and cracking when the casting cools, the trunnion has to be carried clear across the casting. After the casting has cooled, that part of the trunnion that passes the bore of the casting in which the gun rides has to be removed; and to do this by machine would be very slow and costly, so a number of foundries used the Staybolt oxy-acetylene cutting torch for removing the surplus metal. The time

*Extracts from a paper presented at the Annual Convention, International Acetylene Association, New York.

saving as compared with older methods was a tremendous factor in the speed of production.

In making steel shells it had always been customary to take long bars of shell steel and, by means of power-driven saws, cut them into billets for forging. Such companies as first entered into this new work during the years 1916 and 1917 realized that if the tremendous production asked for was to be obtained, some other method of cutting bars and billets would have to be found which could be easily and quickly applied, and which would be so fast that the big forging process would not be idle a moment for lack of billets.

Oxy-acetylene cutting just naturally filled the gap and the wonderful production figures as given in the accompanying table were attained in the majority of the hundred or more plants engaged in this work.

TABLE GIVING PRODUCTION OF SHELL BILLETS BY NICKING AND BREAKING

Diam ter of Bar, In.	Billets per 8-Hr. Day per Operator	Average Depth of Nick, In.	Average Cost per Slug of Nicking, Including Gases, Labor and Breaking, Cents
3⅛	2000	¼	1.55
5¼	800	¼	4.8
9	250	¼	7.5
11¼	100	¼	20.0

Hot-saw or friction-saw nicks gave only about one-quarter of these production figures, while the cost was more than double that of the oxy-acetylene method. It was also found that nicks made by the oxy-acetylene method doubled the number of good breaks as compared with the saw method.

When the process was first applied for the nicking of steel bars, the groove, or nick, was made to considerable depth and over the entire circumference of the bar. As experience was gained the nicking depth was decreased and the cut was made usually only over one-third of the circumference. No additional weight or power in the hammer or breaking press seemed to be necessary and the breaks were even better than when the whole circumference had been nicked.

The process was also applied in some cases to the trimming of the shell edge, after machining the outer and inner surfaces, thereby increasing the speed of this operation as compared with the ordinary cutting-off tool in the lathe by over 50 per cent. A similar application was also made of removing the nubbin or small end remaining at the nose of the shell after machining in the lathe had been completed.

Reference has been made in this paper only to the application in production work, but we must not forget the thousands of applications which were made in the maintenance of plant equipment in conjunction with the oxy-acetylene welding process, thereby keeping producing equipment at top-notch speed. The further use of the process was in such special applications as the cutting of steel lake steamers into two sections so that they might be passed through the Welland Canal, on their way to the ocean to do their bit in carrying the boys across to France; the application made by the English in removing sections of vessels in order to allow the release of imprisoned persons; it is further rumored that the Germans used the oxy-acetylene cutting process in the destroying of artillery which they had to leave behind in their flight.

Can we not, therefore, in true justification, state that the oxy-acetylene cutting process must be, and is, recognized as one of the decisive factors in the winning of the war?

Gaining and Holding the Interest of the Workers

BY ENTROPY

An article under the above heading, on page 399 of *American Machinist*, seems to be lacking in some respects, inasmuch as it does not forcibly call attention to some of the many things that have been tried for the purpose of gaining and holding the workers' interest and failed in their object. The assumption is common that men should receive all of their compensation in their pay envelope and work out for themselves their own salvation in other respects. We cannot, however, expect a workman to continue to respond indefinitely to the impetus of a wage increase; however pronounced the immediate result may be, reaction is inevitable after the newness has worn off.

One thing that has been made evident by the war is that men consider increased wages only in the light of a partial reimbursement for services hitherto inadequately rewarded. Gratitude has nothing to do with it; gratitude is what we feel when we are objects of charity, and no self-respecting man wants to be an object of charity.

Continued high wages serve to stimulate production only when the recipients know that the amount is greater than they could hope to get elsewhere. That is, the value of money is relative; the man who gets more than his fellows is the one who considers himself well paid.

Attempts to hold men to their jobs by various forms of entertainment have lost force since the advent of moving pictures. Before that time men would go to hear their own band or attend an amateur performance by their associates with a considerable degree of satisfaction, but now that they can, for insignificant sums ranging from 11 to 30c. each, hear music that is a real treat and see pictures that have cost thousands of dollars to produce, competition by the employing interests no longer avails.

Base ball, tennis, etc., fall in the same category; they keep a few, a very few, interested, but for the majority of the workers they but constitute another form of entertainment and, except there be players of exceptional ability, soon lose whatever attraction they may have possessed.

Entertainment as a means of holding workers appeals to the average employer for the reason that it is relatively inexpensive; that is, it does not cost nearly so much as would the providing of good working conditions in the shop, good housing, transportation, and food.

The relation between employers and workers should be economic, not social. Men want their money in the pay envelope, to be sure, but they unquestionably appreciate the fact that their money goes farther when working with some firms than is the case with others. They appreciate low rentals if housing conditions are good; they appreciate company stores if they can purchase there the same quality and quantity of goods for less money than elsewhere; they appreciate good, cheap transportation. Nor can they be fooled with respect to any of these things.

Money spent by the employing firm upon entertainment or other means of holding interest that does not get anywhere is looked upon by the men as money that might better have gone into the pay envelope, but money spent in making the employee's dollar go farther than it otherwise would is not only appreciated but helps the whole community to be more thrifty and careful of their expenditures.

Tools for Fusible Plugs and Other Locomotive Parts

BY FRANK A. STANLEY

These tools are for finishing in the brass-working lathe various sizes of fusible plugs and buttons and other brass parts such as hose nozzles and cylinder drain cocks.

A NUMBER of brass-working tools used in the Southern Pacific Co.'s shops at Sacramento, Calif., for making fusible plugs and other brass parts in large quantities are here described and illustrated. Fig. 1 shows a fusible-plug holder and plug, and Figs. 2 and 3 show details of the tools used in their manufacture.

The plugs when chucked for the first operation are held by the heads and turned straight on the body or closed end to the dimensions in Fig. 1. They are also faced on the end to finish the surface and are then placed in the chuck for the internal cuts, where a drill and reamer are run through to produce the central

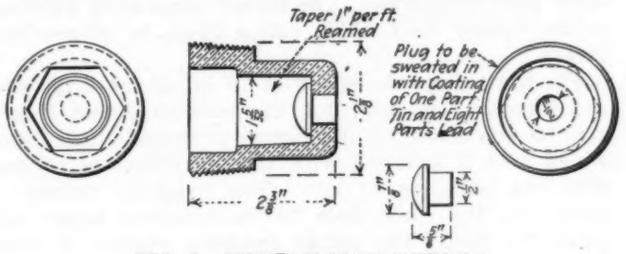


FIG. 1. FUSIBLE-PLUG DETAILS

hole, and followed up by the taper reamers. Details of these taper tools are shown in Fig. 3.

In Fig. 2 the flat reamer to the left is shown with its stop collar or gage in place to limit the depth to which it can be run into the work. The reamer beside it has four flutes and both are made with a taper of 1 in. per foot as called for on the drawing of the fusible plug, Fig. 1.

The fusible button, which is also shown in Fig. 2, is turned on the body to a diameter of ½ in. by means of the hollow mill at the right of the figure. Details of this mill are included in Fig. 3. The head of the button is finished in a second operation with the end-forming portion of the taper tool *A*, Fig. 3, which is also shown in the group in Fig. 2.

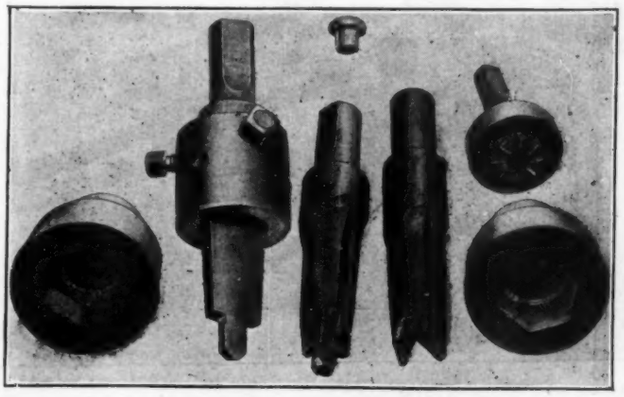


FIG. 2. FUSIBLE PLUG AND TOOLS

DRAIN-COCK TOOLS

The tools in Fig. 4 are for machining cylinder drain cocks, which are also cast in brass, as shown in Fig. 5. The work consists of machining the interior of the body of the appliance and tapping the mouth for one-inch pipe as indicated on the detail drawing.

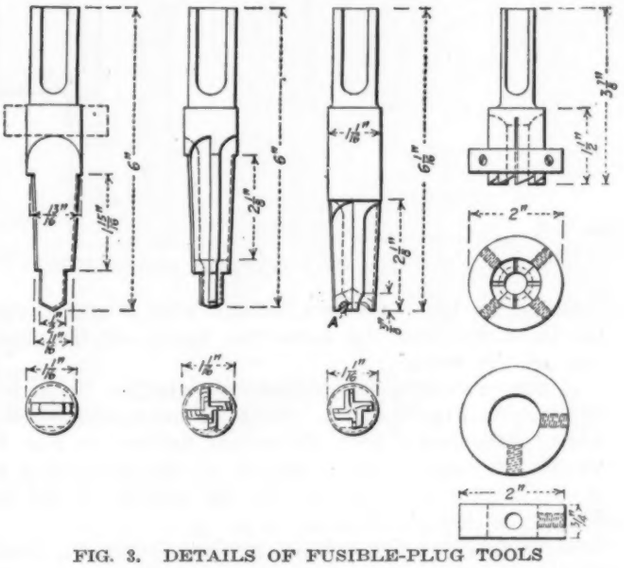


FIG. 3. DETAILS OF FUSIBLE-PLUG TOOLS

A combination drill and taper reamer is first run into the casting to drill a $\frac{21}{64}$-in. hole for the valve spindle at the bottom of the drain cock and to bore and form the valve seat. It also tapers the mouth of the casting to the right dimensions for the 1-in. pipe tap. This

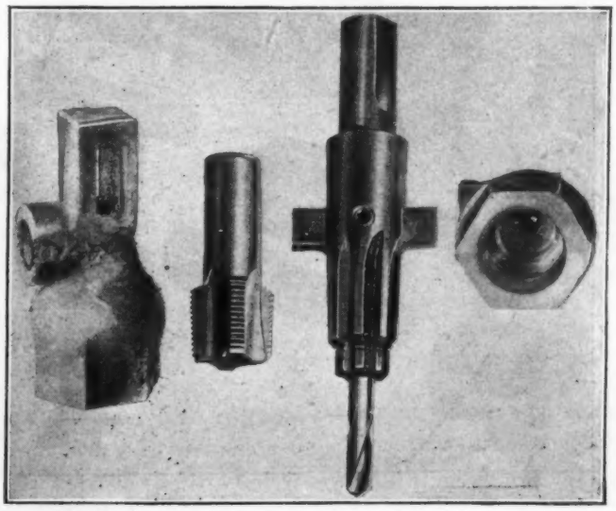


FIG. 4. DRAIN COCK AND TOOLS

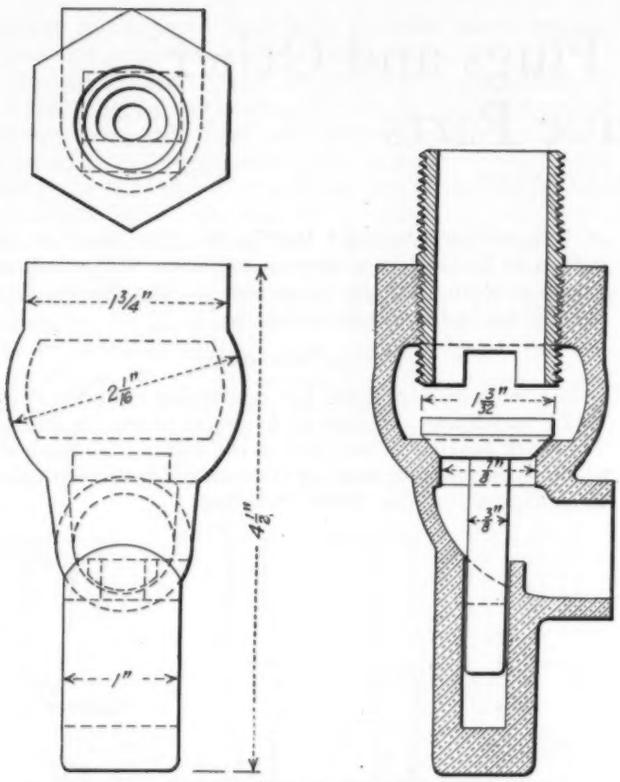


FIG. 5. DETAILS OF CYLINDER DRAIN COCK

combination tool, as shown in both Figs. 4 and 6, also carries a crosswise flat cutter for facing off the outer end of the work.

A very complete set of tools for another brass job is shown in Figs. 7 and 8. They are for machining the hose nozzle shown, with its various fittings, in Fig. 7, where the nozzle body is seen at *A*, the taper plug at *B*, the washer at *C*, the nut for the plug at *D*, the tip or nose of the nozzle at *E*.

Machining the nozzle body involves facing the large end and boring out and tapping for the connection; turning the small end and threading for the nose or tip; taper-reaming the hole for the plug and facing the metal around the ends of the hole.

The flat boring or reaming cutter for machining the large end of the body is shown at *F*, Figs. 7 and 8, and the tap at *G*. The flat cutter is $\frac{5}{16}$-in. stock secured in a plain shank for the turret and has two boring sizes, one for the small hole leading into the body of the nozzle, the other for the tapping size. The wide stage of the cutter takes care of the facing of the end of the body at the same time that the holes are bored.

The small end of the body is turned with the box

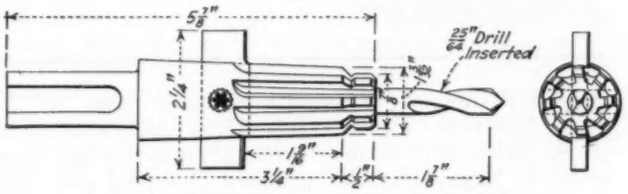


FIG. 6. COMBINATION DRILL AND REAMER

tool *H*, which is made up of a two-winged holder carrying a pair of flat tools which fit in slots planed out in the positions indicated so that the edges of the cutters are in alignment for working uniformly on the shoulders of the nozzle.

The cutters turn the size for the threading of the end, turn the shoulder and face it, and face the small outer end of the body. The thread is made by running on the square die *I* which cuts a 1¼-in. by 14-per-inch thread.

For the taper hole, which is 1¼ in. at the large end and tapers 1¾ in. per foot, the reamers *J* and *K* are applied, the nozzle being gripped in special chuck jaws which hold it squarely with the taper portion in line with the lathe center line. The roughing reamer *J* bores out the cored hole to the required taper and faces the end. The spiral finishing reamer *K* then merely smoothes out the hole. The latter reamer is made with 16 flutes cut on a left-hand spiral to prevent it from feeding into the work too fast.

The taper plug is finished by turning on centers in

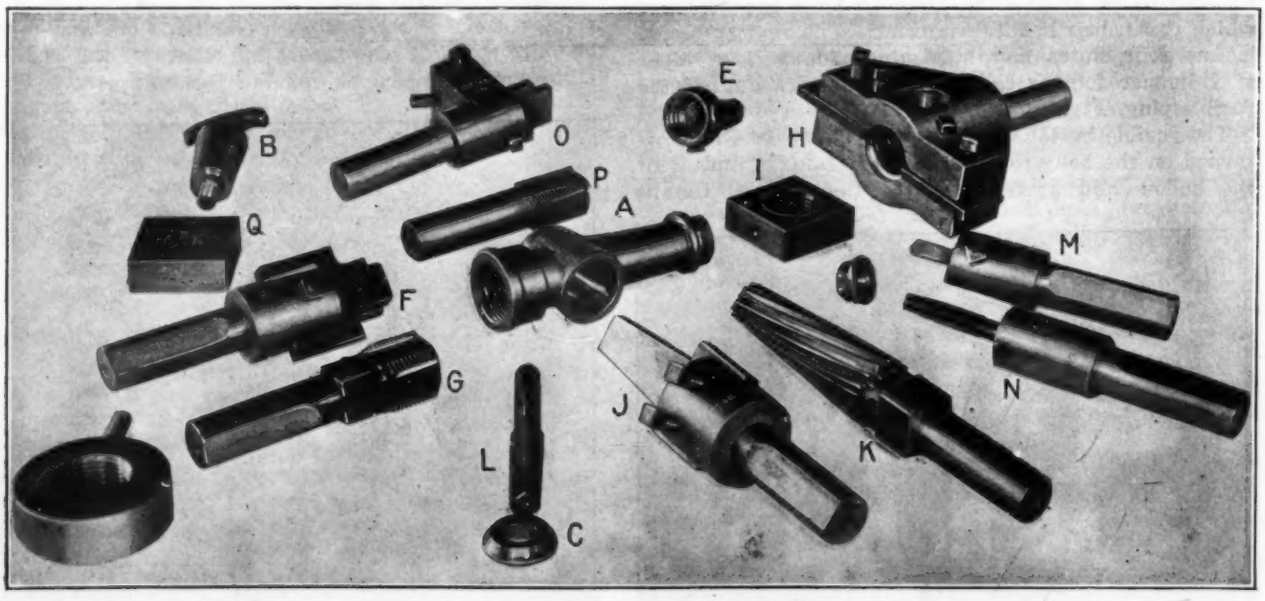


FIG. 7. HOSE-NOZZLE PARTS AND TOOLS

the lathe and is eventually ground into its seat in the nozzle body. Its washer at *C* is finished internally with a flat at one side of the hole to keep it from turning on its bearing, by means of a broach *L* which is cut with a buttress thread of 12 to the inch, so that it looks like a taper tap before it is flatted on one side. It is made to a taper of $\frac{5}{8}$ in. per foot, and the cutting portion is 2 in. long. With this taper and pitch of broaching teeth the increase in size from one tooth to the next is equal to about 0.004 in. and the total taper from point to large end of broach is 0.104 in. The broach thus having a sheared tooth because of the thread which forms its teeth has an easy cutting action and leaves a very smooth hole as a result.

The nut *D* for securing the taper plug in place is made by simply running in the drill and facing tool *M* (a combination flat cutter) and following with the tap *N*, which is $\frac{7}{16}$ by 16 threads per inch.

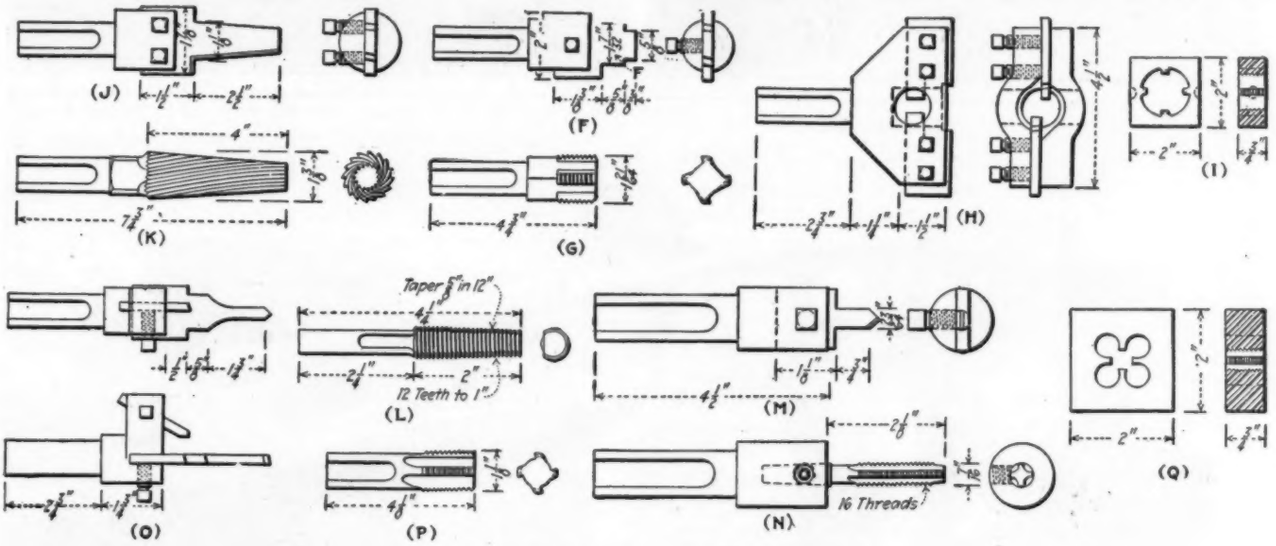


FIG. 8. DETAILS OF HOSE-NOZZLE TOOLS

This fitting *E* is machined by the tool *O* which drills out the hole in front, sizes the rear for the tap *P*, and faces the outer end. At the same time the inserted $\frac{1}{4}$-in. square cutter turns the shoulder to diameter. The tap *P* is then run in to produce a $1\frac{1}{8}$-in. by 14 thread corresponding to the external thread cut with the die on the end of the body of the nozzle *A*.

The die *Q* is for threading the end of the taper plug *B* and cuts a $\frac{7}{16}$ by 16 thread corresponding to the thread formed in the nut *D* by the tap *N*.

Why Not Encourage Home Talent?

BY W. OSBORNE

The article on page 390, under this heading, at least implies that home talent is not encouraged.

"When the average manufacturing plant wants an executive, what procedure is generally followed? Invariably a man is obtained from outside sources," etc.

That may be the writer's experience. He may have been so unfortunate as to have done his observing under surroundings where the aspiring and able employee has been so modest and retiring that he has crawled into a hole out of sight and done the best he could to draw the hole in after himself.

In a plant that I am fairly well acquainted with, about 350 persons are employed. All of the foundry foremen were once workmen. The superintendent was foreman when only one was needed. Every foreman in the machine shop was once a workman there, so was the general foreman and the general superintendent; the head of the traffic department began as a clerk, and so did the head of the sales department. The purchasing agent began as a bookkeeper. The head of drafting and designing began as a machinist; the head of the general office began as a bookkeeper. The vice president began as an apprentice in the machine shop and the president began as machine-shop foreman.

Mr. Price evidently had experience under entirely different conditions. His conclusions may fit those conditions very well, but his statements are too general.

One general superintendent states, as his experience, that it has been hard to induce men to assume responsibility. Often the man who is willing to assume a foreman's job has no qualifications except that willingness. Too often he seems to think that getting such a job will in some mysterious way bring the ability to hold it along with the appointment. If the man who thinks ability is not recognized locally will quietly sit down and think the matter over by himself, from the standpoint of what he would do if he owned and was running the shop, he might get a different viewpoint and one that would help him to find recognition.

Sometimes a man goes to a lot of trouble landing an outside job of responsibility. Perhaps the same amount of effort would have demonstrated his ability locally and received recognition.

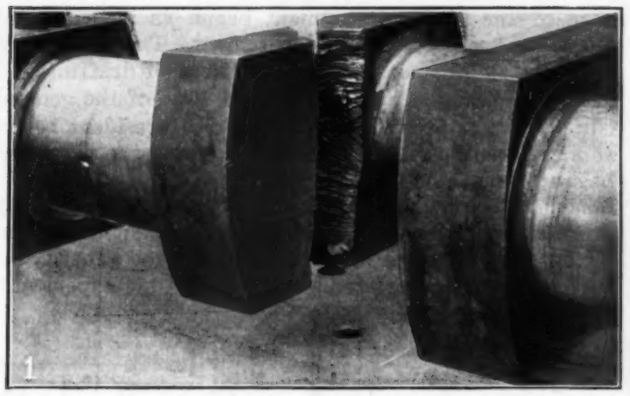
Electric Welding a Six-Ton Crankshaft

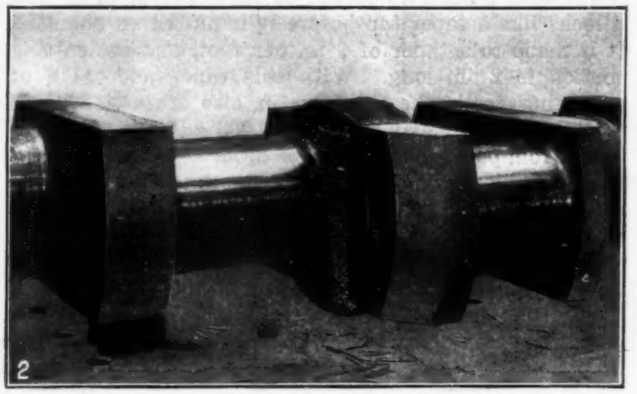
A six-ton crankshaft in the plant of the Houston Ice Co., Houston, Tex., broke through at one of the webs. As there was no means at hand to repair the break, the crankshaft was shipped to the Vulcan Iron Works, Jersey City, N. J., where it was electrically welded by the Wilson plastic-arc process.

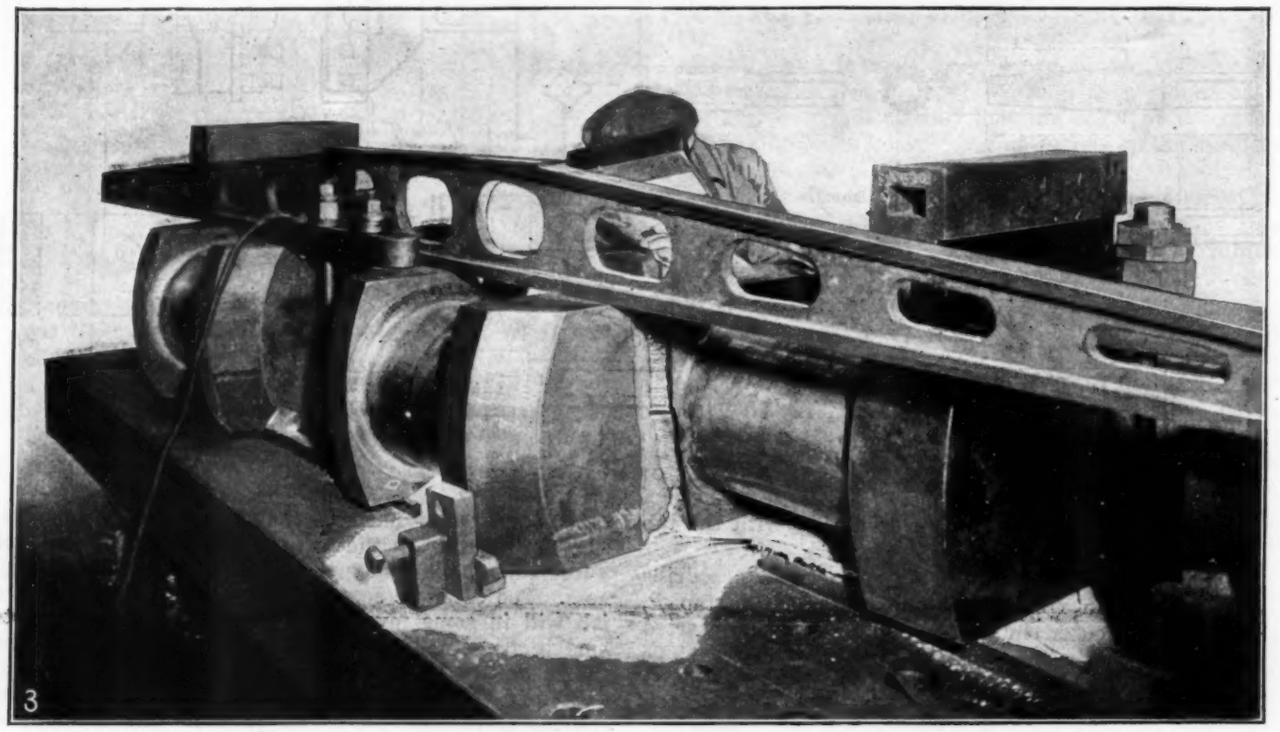
The broken web, cut away preparatory to welding, is shown in Fig. 1, and the finished weld in Fig. 2. Owing to the size of the shaft, great care had to be exercised in keeping it in proper alignment. Fig. 3 shows it leveled and clamped to a large surface plate. A straight-

edge is shown laid across the webs to assist the operator in judging and keeping the alignment.

A big feature in electric welding of this kind, is that owing to the intense heat of the arc, no preheating is required as in using other methods. This, of course, greatly reduces the time required to complete a repair of this kind.







FIGS. 1 TO 3. WELDING OPERATIONS ON A LARGE CRANKSHAFT
Fig. 1—Crankshaft with break cut away for welding. Fig. 2—Completed weld before trimming. Fig. 3—Method of lining up and holding the work.

Cast Bearings for Line Shafting

BY ROBERT MAWSON

The article by E. A. Dixie, on "Rotary Bushings," on page 627, was interesting where he mentions manufacturing these elements of cast iron. This reminds me of a practice which was followed in England by one leading transmission engineer.

This engineer made the bearings for hangers used on line shafting for factories and mills of cast iron, which was somewhat common practice, but the feature of his design of bearings was the fact that the bearings were used without being machined. The bearings, or boxes as they were called, were cast from a medium grade of gray iron and about $\frac{1}{16}$-in. larger bore than the diameter of the shaft used in them.

The high spots were removed by the use of a half-round file and the bearings set up in the hangers. The engineer explained that the surface of the casting, being harder than if it was machined, would last longer, without wear, and that the slight holes or imperfections left by the sand formed oil pockets which retained a film of lubricant for the shaft.

As a matter of fact, these bearings gave good results, some of them being used in one mill about 20 years.

It might be added that the engineer had some faith in the idea, as the boxes were made in two parts without any provision for taking up the wear. The shaft speed was rather slow, as it ran about 150 to 200 r.p.m. The bearings were of one diameter their entire length with a bead at each end which acted as a locating medium for the lower part of the hanger and hanger box.

I have often wondered if a construction of this type would prove efficient on a faster operated shaft but do not recollect ever seeing it tried out.

Metallurgy in Manufacturing High-Speed Steel*

By ROY C. McKENNA

President, Vanadium-Alloys Steel Co., Latrobe, Penn.

For centuries the secret art of making tool steel had been handed down from father to son. The manufacture of tool steel is still an art which, by the aid of science, has lost much of its secrecy; yet tool steel is today made by practical men skilled as melters, hammer-men, and rollers, each knowing his art. These practical men willingly accept guidance from the chemists and metallurgists.

A KNOWLEDGE of conditions existing today in the manufacture of high-speed steel is essential to steel treaters. As a manufacturer of high-speed steel I am glad to give in this paper such information as I am able. It is well for the manufacturer to have steel treaters understand some of his troubles and difficulties, so that they will better comprehend the necessity of certain trade customs and practices, and, realizing the manufacturer's desire to coöperate with them, will reciprocate. This understanding will be mutually beneficial.

The manufacturer of high-speed steel knows and appreciates the troubles and difficulties that may sometimes arise in the heat-treating of his product. His aim is to make a uniform steel that will best meet the requirements of the average machine shop on general work, and at the same time allow the widest variation in heat-treatment to give desired results.

High-speed steel is one of the most complex alloys known. A representative steel contains approximately 24 per cent. of alloying metals, namely, tungsten, chromium, vanadium, silicon, manganese, and in addition there is often found cobalt, molybdenum, uranium, nickel, tin, copper and arsenic.

Standard Analysis

The selection of a standard analysis by the manufacturer is the result of a series of compromises between various properties imparted to the steel by the addition of different elements and there is a wide range of chemical analyses of various brands. The steel, to be within the range of generally accepted analysis, should contain over 16 per cent. and under 20 per cent. tungsten; if of lower tungsten content it should carry proportionately more chromium and vanadium.

The combined action of tungsten and chromium in steel gives to it the remarkable property of maintaining its cutting edge at relatively high temperature. This property is commonly spoken of as "red-hardness." The percentages of tungsten and chromium present should bear a definite relationship to each other. Chromium imparts to steel a hardening property similar to that given by carbon, although to a less degree. The hardness imparted to steel by chromium is accompanied by brittleness. The chromium content should be between 3½ and 5 per cent.

Vanadium was first introduced in high-speed steel as a "scavenger," thereby producing a more homogeneous product, of greater density and physical strength. It soon became evident that vanadium used in larger quantities than necessary as a scavenger imparted to the steel a much greater cutting efficiency. Recently, no less an authority than Prof. J. O. Arnold, of the University of Sheffield, England, stated that "high-speed steels containing vanadium have a mean efficiency of 108.9, as against a mean efficiency of 61.9 obtained from those without vanadium content." A wide range of vanadium content in steel, from ¼ to 1½ per cent., is permissible.

An ideal analysis for high-speed steel containing 18 per cent. tungsten is a chromium content of approximately 3.85 per cent.; vanadium, 0.85 per cent. to 1.10 per cent., and carbon, between 0.62 and 0.77 per cent.

Detrimental Elements

Sulphur and phosphorous are two elements known to be detrimental to all steels. Sulphur causes "red-shortness" and phosphorous causes "cold-shortness." The detrimental effects of these two elements counteract each other to some extent but the content should be not over 0.02 sulphur and 0.025 phosphorous. The serious detrimental effect of small quantities of sulphur and phosphorous is due to their not being uniformly distributed, owing to their tendency to segregate.

The manganese and silicon contents are relatively unimportant in the percentages usually found in high-speed steel.

The detrimental effects of tin, copper and arsenic are not generally realized by the trade. Small quantities of these impurities are exceedingly harmful. These elements are very seldom determined in customers' chemical laboratories and it is somewhat difficult for public chemists to analyze for them.

In justice to the manufacturer, attention should be called to the variations in chemical analyses among the best of laboratories. Generally speaking, a steel works' laboratory will obtain results more nearly true and accurate than is possible with a customer's laboratory, or by a public chemist. This can reasonably be expected, for the steel works' chemist is a specialist, analyzing the same material for the same elements day in and day out.

The importance of the chemical laboratory to a tool-steel plant cannot be over-estimated. Every heat of steel is analyzed for each element, and check analyses obtained; also, every substance used in the mix is analyzed for all impurities. The importance of using pure base materials is known to all manufacturers despite chemical evidence that certain detrimental elements are removed in the process of manufacture.

The manufacture of high-speed steel represents the highest art in the making of steel by tool-steel practice. Some may say, on account of our increased knowledge of chemistry and metallurgy, that the making of such steel has ceased to be an art, but has become a science. It is, in fact, an art; aided by science. The human element in its manufacture is a decided factor, as will be brought out in the following remarks:

The heat-treatment of steel in its broad aspect may be said to commence with the melting furnace and end with the hardening and tempering of the finished prod-

*Abstract of an address delivered at the convention of the American Steel Treaters' Society, Chicago, Ill.

uct. High-speed steel is melted by two general types of furnace, known as crucible and electric. Steel treaters, however, are more vitally interested in the changes that take place in the steel during the various processes of manufacture rather than a detailed description of those processes, which are more or less familiar to all.

In order that good high-speed steel may be furnished in finished bars, it must be of correct chemical analysis, properly melted and cast into solid ingots, free from blow-holes and surface defects. Sudden changes of temperature are to be guarded against at every stage of its manufacture and subsequent treatment. The ingots are relatively weak, and the tendency to crack due to cooling strains is great. For this reason the hot ingots are not allowed to cool quickly, but are placed in furnaces which are of about the same temperature and are allowed to cool gradually before being placed in stock. Good steel can be made only from good ingots.

Steel treaters should be more vitally interested in the important changes which take place in high-speed steel during the hammering operations than that of any other working the steel receives in the course of its manufacture.

Quality and Structure

The quality of high-speed steel is dependent to a very great extent upon its structure. The making of the structure begins under the hammer, and the beneficial effects produced in this stage persist through the subsequent operations, provided they are properly carried out. The massive carbides and tungstides present in the ingot are broken down and uniformly distributed throughout the billet.

To accomplish this the reduction in area must be sufficient and the hammer blows should be heavy, so as to carry the compression into the center of the billet; otherwise, undesirable characteristics such as coarse structure and carbide envelopes will exist and cause the steel treater much trouble. Surface defects invisible in the ingot may be opened up under the hammering operation, in which event they are chipped from the hot billet.

Ingots are first hammered into billets. These billets are carefully inspected and all surface defects ground or chipped. The hammered billets are again slowly heated and receive a second hammering, known as "cogging." The billet resulting therefrom is known as a "cogged" billet and is of the proper size for the rolling mill or for the finishing hammer.

Although it is not considered good mill practice, some manufacturers who have a large rolling mill perform the very important cogging operation in the rolling mill instead of under the hammer. Cogging in a rolling mill does not break up and distribute the carbides and tungstides as efficiently as cogging under the hammer; another objection to cogging in the rolling mill is that there is no opportunity to chip surface defects developed as they can be under the trained eye of a hammer-man, thereby eliminating such defects in the finished billet.

The rolling of high-speed steel is an art known to very few. The various factors governing the proper rolling are so numerous that it is necessary for each individual rolling mill to work out a practice that gives the best results upon the particular analysis of steel it makes. Important elements entering into the rolling are the heating and finishing temperatures, draft, and speed of the mill. In all of these the element of time must be considered.

High-speed steel should be delivered from the rolling mill to the annealing department free from scale, for scale promotes the formation of a decarbonized surface. In preparation of bars for annealing, they are packed in tubes with a mixture of charcoal, lime, and other material. The tubes are sealed and placed in the annealing furnace and the temperature is gradually raised to about 1650 deg. F., and held there for a sufficient length of time, depending upon the size of the bars. After very slow cooling the bars are removed from the tubes. They should then show a Brinnell number of between 235 and 275.

The inspection department ranks with the chemical and metallurgical departments in safeguarding the quality of the product. It inspects all finished material from the standpoint of surface defects, hardness, size and fracture. It rejects such steel as is judged not to meet the manufacturer's standard. The inspection and metallurgical departments work hand in hand, and if any department is not functioning properly it will soon become evident to the inspectors, enabling the management to remedy the trouble.

The successful manufacture of high-speed steel can only be obtained by those companies who have become specialists. The art and skill necessary in the successful working of such steel can be attained only by a man of natural ability in his chosen trade, and trained under the supervision of experts. To become an expert operator in any department of its manufacture, it is necessary that the operator work almost exclusively in the production of such steel.

As to the heat-treatment, it is customary for the manufacturer to recommend to the user a procedure that will give to his steel a high degree of cutting efficiency. The recommendations of the manufacturer should be conservative, embracing fairly wide limits, as the tendency of the user is to adhere very closely to the manufacturer's recommendations. Unless one of the manufacturer's expert service men has made a detailed study of the customer's problem, the manufacturer is not justified in laying down set rules, for if the customer does a little experimenting he can probably modify the practice so as to produce results that are particularly well adapted to his line of work.

The purpose of heat-treating is to produce a tool that will cut so as to give maximum productive efficiency. This cutting efficiency depends upon the thermal stability of the complex hardenites existing in the hardened and tempered steel. The writer finds it extremely difficult to convey the meaning of the word "hardenite" to those that do not have a clear conception of the term. The complex hardenites in high-speed steel may be described as that form of solid solution which gives to it its cutting efficiency. The complex hardenites are produced by heating the steel to a very high temperature, near the melting point, which throws into solution carbides and tungstides, provided they have been properly broken up in the hammering process and uniformly distributed throughout the steel. By quenching the steel at correct temperature this solid solution is retained at atmospheric temperature.

It is not the writer's intention to make any definite recommendations as to heat-treating of high-speed steel by the users. It is recognized that such steel can be heat-treated to give satisfactory results by different methods. It is, however, believed that the American practice of hardening and tempering is becoming more uniform. This is due largely to the ex-

change of opinions in meetings such as this. The trend of American practice for hardening is toward the following:

First, slowly and carefully preheat the tool to a temperature of approximately 1500 deg. F., taking care to prevent the formation of excessive scale.

Second, transfer to a furnace, the temperature of which is approximately 2250 to 2400 deg. F., and allow to remain in the furnace until the tool is heated uniformly to the above temperature.

Third, cool rapidly *in oil*, dry air blast, or lead bath.

Fourth, draw back to a temperature to meet the physical requirements of the tool, and allow to cool in air.

It was not very long ago that the desirability of drawing hardened high-speed steel to a temperature of 1100 deg. was pointed out, and it is indeed encouraging to learn that comparatively few treaters have failed to make use of this fact. Many treaters at first contended that the steel would be soft after drawing to this temperature and it is only recently, since numerous actual tests have demonstrated its value, that the old prejudice has been eliminated.

High-speed steel should be delivered only in the annealed condition because annealing relieves the internal strains inevitable in the manufacture and puts it in vastly improved physical condition. The manufacturer's inspection after annealing also discloses defects not visible in the unannealed state.

The only true test for a brand of high-speed steel is the service that it gives by continued performance month in and month out under actual shop conditions. The average buyer is not justified in conducting a test, but can well continue to purchase his requirements from a reputable manufacturer of a brand that is nationally known. The manufacturer is always willing to coöperate with the trade in the conducting of a test and is much interested in the information received from a well conducted test. A test, to be valuable, should be conducted in a manner as nearly approaching actual working conditions in the plant in which the test is made as is practical. In conducting a test a few reputable brands should be allowed to enter. All tools entered should be of exactly the same size and shape. There is much difference of opinion as to the best practical method of conducting a test, and the decision as to how the test should be conducted should be left to the customer, who should coöperate with the manufacturers in devising a test which would give the best basis for conclusions as to how the particular brands would perform under actual shop conditions.

The value of the file test depends upon the quality of the file and the intelligence and experience of the person using it. The file test is not reliable, but in the hands of an experienced operator, gives some valuable information. Almost every steel treater knows of numerous instances where a lathe tool which could be touched with a file has shown wonderful results as to cutting efficiency.

Modern tool-steel practice has changed from that of the past, not by the use of labor-saving machinery, but by the use of scientific devices which aid and guide the skilled craftsman in producing a steel of higher quality and greater uniformity. It is upon the intelligence, experience, and skill of the individual that quality of tool steel depends.

Uniform Cost Accounting*

By WILLIAM R. BASSET

I HAVE frequently talked to a man and endeavored to impress upon him the advantages to be attained in the installation of cost finding methods. Frequently my auditor has endeavored to shut me up by saying, "I have made a sufficiency of profits in the last five or ten years. I have averaged so many tens or hundreds of thousands of dollars upon my sales. What better can I ask? I do not want to change. Why should I take on new tasks, new responsibilities and new duties?"

I think that his answer brings up the question every one of you should have in your mind; not whether you are making a profit, but whether you are making all of the profit that you can make. In fact, my address, should be entitled "The Sufficiency of Profit" rather than "Uniform Costs."

I am going to avoid a discussion of the detail of cost finding, because I have learned that in an association meeting of this kind, those present are principally the heads of companies. The machine-tool building companies are, in the majority, large companies. You, the heads of these companies, do not want to bother yourselves with the details of cost finding, and where one man may err and be interested in a correcting method if described by me, the next nineteen may be doing the same thing quite properly. Therefore, I do not want to distress the nineteen by a trip through details they may already have mastered.

I merely want to emphasize one point of the many to be remembered in cost finding. It is an administrative one, and you should in turn impress it upon your cost clerks, foremen, and other subordinates. Be sure that you get into your costs every expense your company incurs. Necessarily, you must get these expenses back to make a profit. You can get them back only out of your customers, by passing the expenses on to them as a part of the cost on which your sales prices are based.

Labor bonuses are frequently not included in the costs. You have ascertained what your overhead expense is under normal conditions. You know what your labor expense is under normal conditions. Then you slap a bonus on to get increased production and though you get more production you neglect to put that bonus into your overhead, and increase your overhead.

In the old days, it was a fairly safe procedure to ascertain a cost, once or twice a year, and within certain limitations, to stick to that cost. Today, you have widely varying material costs; your labor conditions change from day to day—and I speak not only of the individual rates, but of the amount of work that you get out of your workmen, and your overhead necessarily varies from month to month, dependent on your output.

We have this year encountered fluctuations in overhead of from 150 to 225 per cent., the fluctuations

*Abstract of an address delivered before the National Machine Tool Builders' Association, Oct. 15, 1919.

occurring monthly for six consecutive months. The conditions were of a type over which the management had no control. The plant had plenty of work to do. It was not a case of idleness due to insufficient sales. It was that they could not control the production in their plant.

You must have a sort of a clinical thermometer tucked away in the corner of your business mouth that is going to tell you at least monthly what the variations in your costs are, so that you can go out and you can compete intelligently. Only the best of cost systems will fulfill your need.

I think unintelligent competition is the worst thing that you have to face.

How many manufacturers who arrive at a cost and add on 20 per cent. actually, at the end of the year, find that they have made 20 per cent. on the sales as a whole? I am not speaking of the last year or two of war profits. I know a whole lot of machine-tool builders who made a lot more than 20 per cent.; but I am speaking of normal times and normal conditions.

A man who has a machine tool to sell that costs, complete on the shipping-room floor, $2000, may add $400 or 20 per cent. for profit and sell it at $2400. At the end of the year, that man, if he has sold $2,400,000 worth of machine tools should have $400,000 worth of profit. This is, however, seldom the result, and if the profit as a whole is less than the profit sought on the individual sale, there is only one answer; he has neglected to include all his expenses in his costs.

I imagine a warning to include depreciation, to the extent possible, is needless here; that is good business from a cost standpoint and from a tax standpoint. The Government will tell you how far you can go in that direction.

Cannot Include Federal Taxes

There is one thing that you unfortunately cannot do; and that is, include the Federal taxes you must pay to the Government in your costs. You should include them from a theoretical standpoint; but the reason it is impossible to do so practically, is that until you have arrived at a determination of what your profits are, you do not know what your taxes are going to be.

It is not possible at the end of each month to say, "I have made so many thousands of dollars, of which I will pay a certain amount to the Government." Your taxes are not determined until the last moment, and until you find out what your invested capital is; until you find out what your profits are; only then will you know into what tax per cent. class you will be forced by the Government.

The Government declares itself, in a way, as a preferred stockholder of your company. It is something like radical labor—it insists on being given a part of your profit; it does not share any of your losses.

If you were to add a percentage to your costs for your Federal taxes, you might put your costs up to a point where you could not sell. If you did not sell, you would operate at a loss. If you operated at a loss, you would not have any taxes to pay. Therefore, to include taxes in the first place is an error that, if followed, may prevent you from doing business. The only thing that you can do after you have determined upon a profit is to make a mental calculation and say "I should have so much profit for myself, and the Government will probably take such and such a per cent. of that profit; therefore, is the amount that is left to me sufficient?" If not, increase the per cent. of profit sought by you.

The Government a Preferred Creditor

It is extremely interesting, and vitally necessary, that you know what your taxes will be within certain limits. Remember that the Government is a preferred creditor. It demands its money on the spot.

You may have certain housing plans; certain plans to expand. You may want to put some of your money back into your business; but you can only afford to put back the amount of profit you will have left free after the Government has taken its share; hence, it is desirable to know about what you will have to pay.

I may say to those who have not studied the 1919 taxes, that they differ rather materially from 1918. In 1918, it was possible for some companies who made prodigious profits, to be obliged to pay 83 cents out of every dollar, over and above a certain per cent., to the Government. This year, after you have attained a certain percentage of profit you may be forced to pay 46 cents out of every dollar to the Government plus, in the State of New York, 4½ per cent., which means that you will have to give over half of your profit away.

If your business has continued to grow as it should, a certain amount of your profits are diverted into other channels. Your accounts receivable should be larger, because you are doing more business. You may have to carry a greater number of finished machines. You may have more goods in process on the floor; in fact, we find it almost invariably true, that if a company has made $100,000, at least $50,000 of that money is in some way or other tied up in the expansion of the business, even if you do not build more factories or additions to your plant on a monumental scale.

I may say from the tax standpoint, that I have no desire to depress you gentlemen, but we have some advantages through our contact with various Government bureaus and sources of information, as the result of which I do not apprehend any reduction in taxes for some time.

There have been a number of rumors afloat to the effect that perhaps excess profit taxes might be cancelled.

The Government requirements are such that nothing but a very slight reduction in taxes can take place; so that we can rest confident, if unhappy, in the fact that in 1919 and 1920 we will have the present scale of taxes with us. In the fall of 1921 we may get some sort of a bill through that will be retroactive, for that year, and that will somewhat decrease taxes. The decrease will not be material.

Now, the lesson to be learned is that even if you can make fair profits, you are going to give a lot of it to the Government. You can hardly avoid putting the rest into the ordinary business requirements of your company and thus you will have very little left for distribution.

If the invested capital is half a million dollars, and the profit is $100,000, the tax will be $20,000 or just about twenty per cent.; that is the case of a small company.

Let us take the other extreme, a company of five million dollars that has made forty per cent. on its

invested capital. Its profit will be $2,000,000. Its taxes will be $667,000, or about 33 per cent. of all that it has made. Taking the extreme limit of a company, of we will say, one million dollars that has made fifty per cent. profit; its profit will be $500,000; its taxes will be $178,000. That appears to be a little bit less than the 40c. per dollar I spoke of; but remember, this is a total tax; the Government takes only eight per cent. of the first ten per cent., and it is the amounts over ten per cent. that are finally taxed, in some cases 46 per cent. If you can get into that high class you may believe that you are swimming in profits; actually you are merely the temporary custodian of the profits.

In short, if you have been at all fortunate in profit making, you must count upon losing one-half of the money you have patted yourselves on the back for making.

Dropping taxes again for the moment and reverting to the need of uniform cost; it is unintelligent competition that you should fear more than anything else.

An Example of Uniform Cost Methods

Some months ago I made an examination for the Sanitary Pottery Association. We examined the records of every pottery within the association. Forty per cent. of the potteries had uniform cost methods put in at about the same time, and based on the same principles. We made an examination of the cost of two articles made by all of the potters. We found that the high cost on one ran $7.03, and the low cost, $3.43. In short, some of the manufacturers were 100 per cent. higher than the others.

It is a curious fact that the 40 per cent. of the manufacturers who had uniform cost systems, ranged from $6.60 to $7.03. Forty per cent. of the costs were up within a few cents of the high price. These men had put in all of their expenses, and were getting their true cost. On the other hand, there were two or three below the $4 limit. These manufacturers did not know what their costs were. One of them, I remember, had left his fuel cost out entirely, because he did not know how to handle it; and when you consider the effect of the elimination of fuel in a business such as the potters, where the fuel part of the kiln operating cost is the big element, you can realize what was left out.

As an association I urge you to endeavor to take a new hold on the uniform cost question, and to force on your brethren, who are reluctant to go ahead, a knowledge of costs that will make them better competition for you.

Insuring Against Spoilage

By Peter F. O'Shea

The problem of spoiled work bears on every shop which does special orders for a few duplicate pieces. In a machine shop, especially where machines have to be set up for each dimension and a couple of thousandths of an inch may spoil the work, it is quite easy and indeed unavoidable to have accidents. Since it is impossible to avoid them, the next best thing is to get them down to a scientific basis.

One shop doing comparatively small work has made a study of the percentage of inevitable spoilage, and knows ahead just how many pieces are liable to be spoiled. It has a method of discounting them the same as an insurance company discounts its losses during the year by providing itself with enough premiums.

An extra duplicate piece is always routed, even for small orders. If the order is larger, more than one extra piece is routed, on a sliding scale, which experience has determined will be sure to provide a margin over all possible tricks of fate. When six pieces or less are ordered, seven are routed. When 12 pieces are ordered, 14 pieces are routed. For 50 pieces, 55 pieces are routed. Above that, 10 per cent. is added to allow for spoilage. On the routing sheet are two spaces, one labeled "Number wanted" and the other labeled "Number to make."

Determining Number of Extra Pieces

The number of extra pieces necessary to route is determined somewhat in the same way as the rate of insurance, by statistics on the percentage of fatalities, doubled or tripled to give an ample margin of space. The resulting cost shows a very great saving over what the cost would be in the aggregate if it were left to happy-go-lucky chance.

If one of the pieces falls by the wayside somewhere on the route, the loss is charged up against the record of the workman responsible. But the surviving pieces go on their way and when they are finished the customer's order is intact and complete, ready for shipment.

This method insures quick delivery to the customer of his full order.

If a customer orders a half-dozen duplicate pieces, he wants a half-dozen. He does not like to receive five with the explanation that the other one was spoiled in process. On the other hand, if the manufacturer stops to replace the single spoiled piece he will have to repeat the entire routing for one piece and go through the setting up of machines all over again. This causes delay. The customer does not want delay.

The Method Is Cheaper

The present method is cheaper for the customer, as the small total cost of the extra pieces under this method is divided up among all the customers. Compare it with the total cost which would result from re-routing single pieces now and then for replacement. It does not cost a great deal more to make seven duplicate pieces than it does six, if the machines are set up and the seven are all run together; but it costs much more to make one more tap routed over again all by itself.

Even if the loss from spoilage were passed on to the individual customer, each customer would find that he would be very much out of profit every once in a while if fatalities were not insured against.

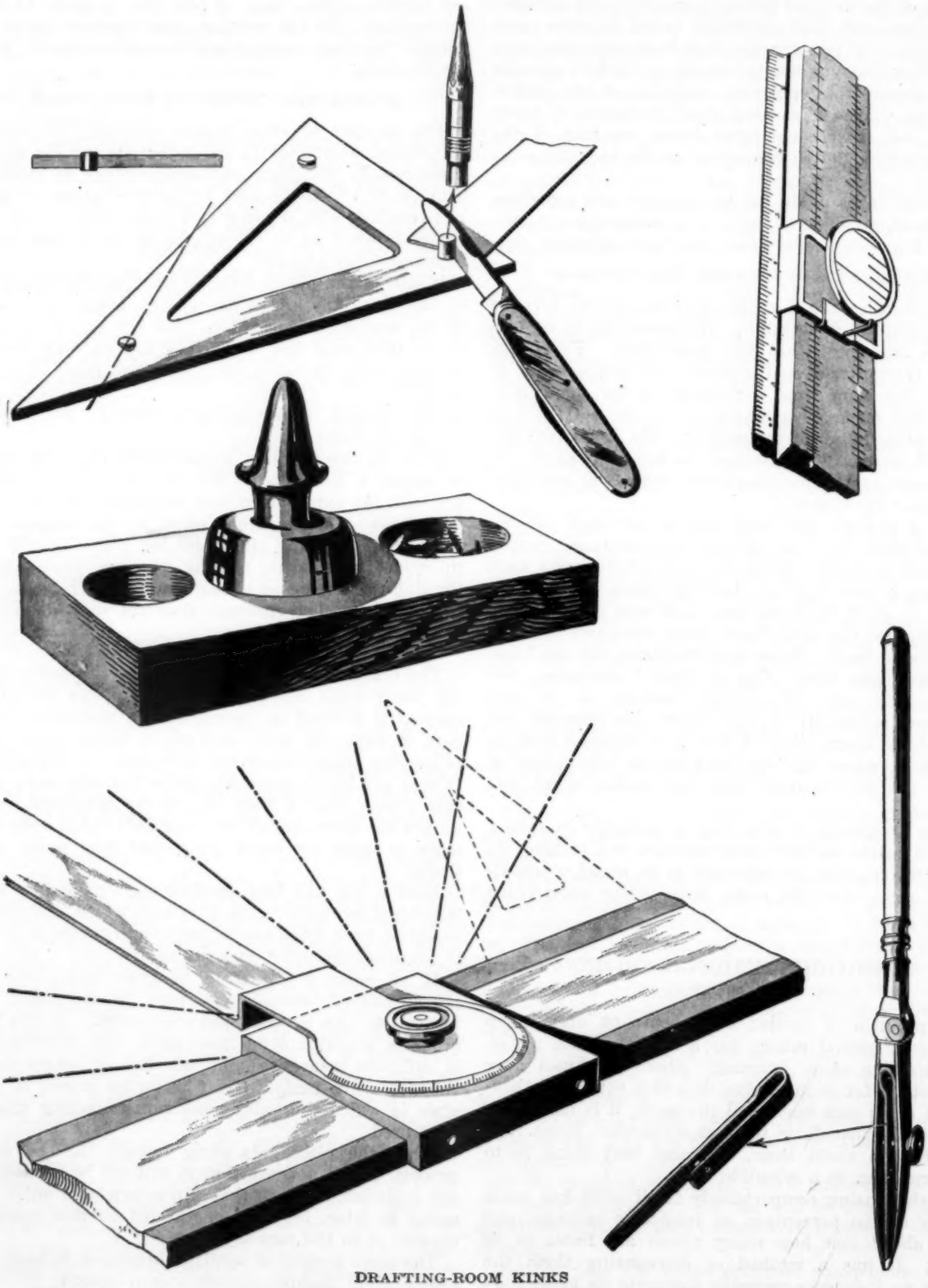
If all seven pieces of a six-piece order are completed without spoilage and pass the necessary rigid inspection, the seventh piece is saved. If the same order is repeated some time later, this seventh piece is sufficient insurance, and only the six pieces freshly called for are made. Or if an order comes in for a style to which the extra piece can be quickly changed, it is used.

When the piece gets along toward the end of the process, and it appears that it will not be needed, it is put aside into stock so that if a somewhat similar order comes in later, the final operations on this piece may convert it to the new style.

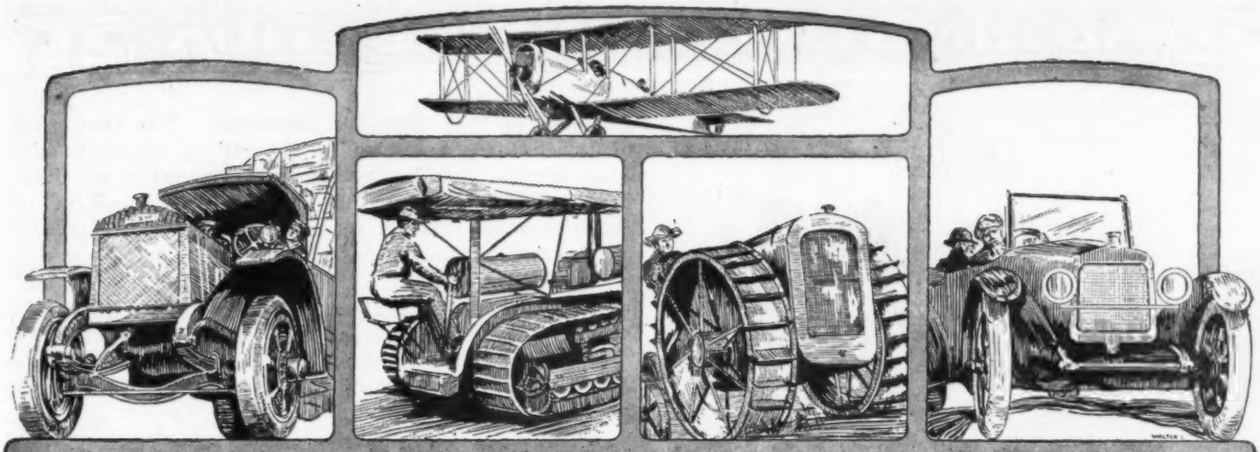
The same method of spoilage insurance is used in an emery-wheel factory, on all special orders.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS



Assembling Liberty Motor Connecting-Rods

By H. A. CARHART
Mechanical Engineer, Lincoln Motor Co., Detroit.

The methods of testing alignment and clearances suggest other applications of similar devices in other kinds of motor work as well as in other fields. Tool designers and inspectors will find this article particularly helpful.

With the exception of the operations on the forked ends, both connecting-rods present similar machining problems, and with the exception of a little profiling around the large end of the single rod, the methods are similar in both cases.

The first assembling operation is to press in the piston-pin bushing on a No. 3½ Greenard arbor press. The rod is held in a horizontal position, supported on a boss and the edges of the channel. The bronze bushing is placed on a pilot pin, so that the oil hole in the bushing lines up with the oil hole in the rod, this operation being the same on all rods. Production is 1000 pieces in 9 hours.

The small end of the rod is then heat-treated to relieve stresses set up by forcing in the bushing. This is done by hanging the rods by their large ends so that the small end will be just covered by an oil bath having a flash point of 500 deg. This oil is heated to 350 deg. F. and the rod is allowed to remain in this position 30 min. They are then washed in kerosene, the production being 800 pieces in 9 hr. by one man.

The piston-pin bushing is then rough-reamed to 1.248

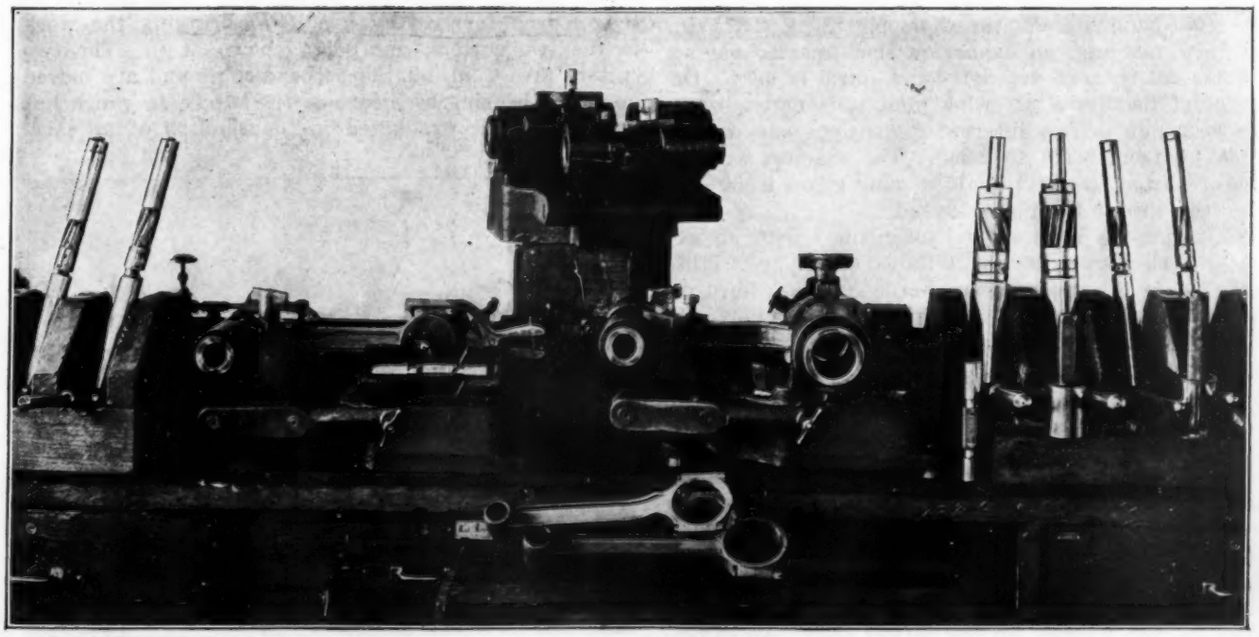


FIG. 1. FINISH-REAMING ROD BEARINGS

AUTOMOTIVE CONSTRUCTION

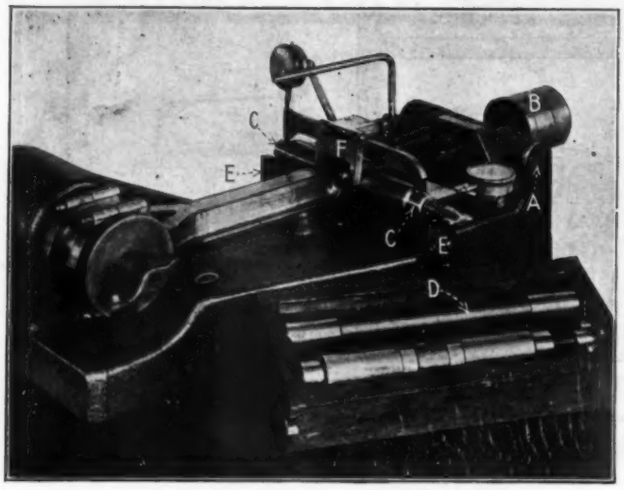


FIG. 2. CHECKING PARALLELISM OF HOLES

in., the production being 700 pieces in 9 hr., by one man.

The rod caps are then counterbored for the dowel, and the crank-pin bearing fitted to the rod. The dowel is then driven in with a special punching tool, the cap placed in the fixture and the dowel headed over with a 10-oz. ball peen hammer. The bearing is forced into the fork of the rod by placing a special tool in the bearing and driving lightly with a lead hammer until the edges of the bearing and the face of the bolt boss are flush. Both holes are then blown out with an air hose. The rod is taken from the vise and tested by sound to find if the bearing is solidly in place. This can be readily detected by the kind of ring it gives. Production is 10 pieces an hour by one man.

The next operation is rough- and finish-reaming the crank-pin bearing and to finish-ream the piston-pin bushing. The crank-pin bearing is reamed with an expansion shell reamer having 14 flutes cut with 10-deg. right-hand spirals, the diameter being 2.374 in. For finish-reaming, an expansion shell reamer having 10 flutes cut on a 25 deg. left-hand spiral is used. On account of the limits on crank pins, it is necessary to ream bearings to five different dimensions varying by 0.0005 in. from 2.378 to 2.380. The reamers are set to the required size by the aid of ring gages 0.0005 in. under the size of the holes desired.

The piston-pin bushing is hand-reamed with an expansion shell reamer having 10 flutes, cut 10 deg. right-hand spiral. All reamers are hardened glass hard on cutting edges, and crank-pin bearings must be perfectly smooth and free from spirals after reaming. Production on both these forked and plain rods is 350 pieces in 9 hr. by one man.

The reamer fixtures are shown in Fig. 1, the one at the left being for the single rods and the one at the right for the forked rod. This also shows the reamers used and the testing fixture which is shown elevated in the center. The plug gages for the holes and the ring gages for setting the reamers to correct size are also shown.

The rods are next tested for alignment, the fixture shown in Fig. 2 being for the forked rods. An expansion arbor fits the crank-pin bearings and an arbor is fastened in the piston-pin bushings. The rear part of the fixture is hinged at *A*, and is normally held in a vertical position by the counterweights *B*. Part of the fixture has two arms, and when brought to the horizontal position shown, a button near each end of the arm comes in contact with the arbor *C*, which is in the piston-pin hole. The arm swings on a pivot and the two dial indicators shown, fastened to suitable supports, record the vertical and horizontal alignment of the hole. The test arbor *D*, when placed in the blocks *EE*, form a gage for setting the dial indicators.

If the indicators show the holes to be out of alignment, the rod is straightened by use of a bending tool. The gage *F*, which is attached to the back end of the fixture, is then swung down to test whether the piston-pin boss is central with the crank-pin bearing. Similar methods are used for testing the plain rod. The production is 700 pieces in 9 hr. by one man.

When the piston-pin bushing extends beyond the boss, a spot-facing operation becomes necessary, after which the rods must be burred on the inside with a scraper, and on the outside with a file. The rods are next weighed and the weight marked on the side. Forked rods are made up into sets of six each, the maximum variation in a set being $\frac{1}{4}$ oz. One woman handled 1800 pieces in 9 hr. The forked-rod bolts are next numbered from 1 to 4 on the head, and a corresponding number stamped on the boss of the rod and cap, $\frac{1}{8}$-in. steel stamps being used. The letter R is stamped on one side of the rod, just below the fork on the same side as the bolts are numbered 1 and 2. From this point on, the rods are kept in sets of six. Production is 1200 pieces in 9 hours.

Next comes the turning of the outside of the crank-pin bearing as shown in Fig. 3. This is to insure both the outside and inside being absolutely concentric after assembling. The rod is held by an expansion arbor which fits into the crank-pin bearing and a lug which fits in the channel of the rod. The table *A* is then moved forward by handle *B*, bringing the work to the two cutters, one being shown at *C*. The two cutters are $\frac{1}{32}$ in. off the perpendicular and are moved up to the bearing by means of the handle *D*, which has an index collar graduated in thousandths of an inch.

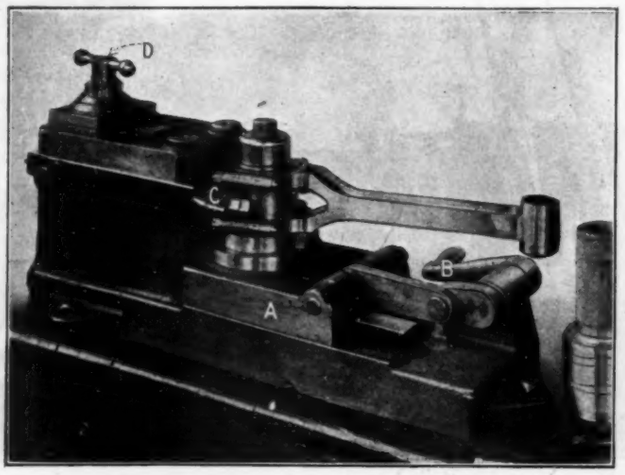


FIG. 3. FINISH-TURNING ROD BEARING

AUTOMOTIVE CONSTRUCTION

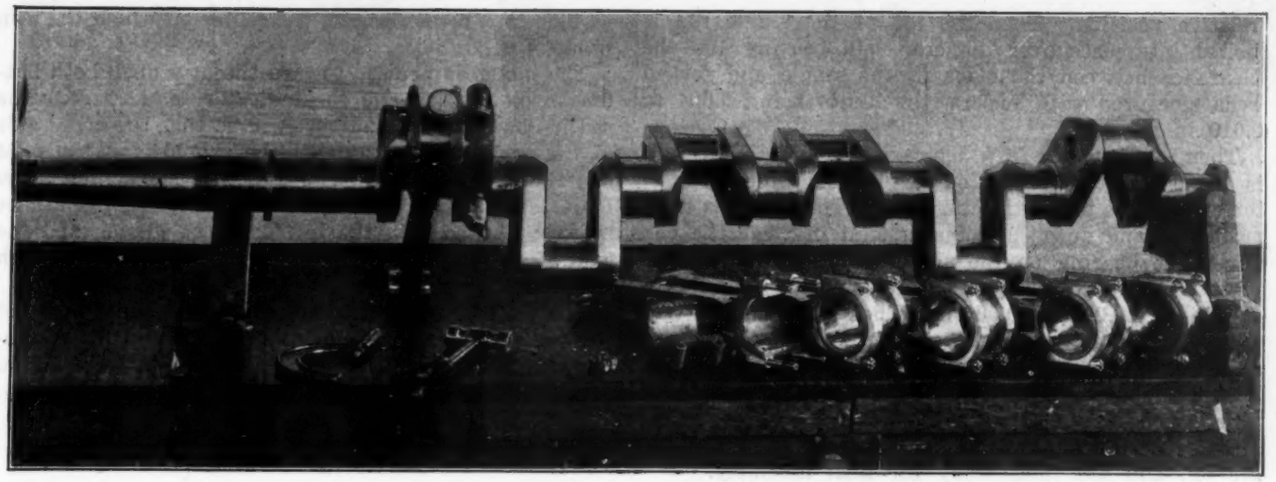


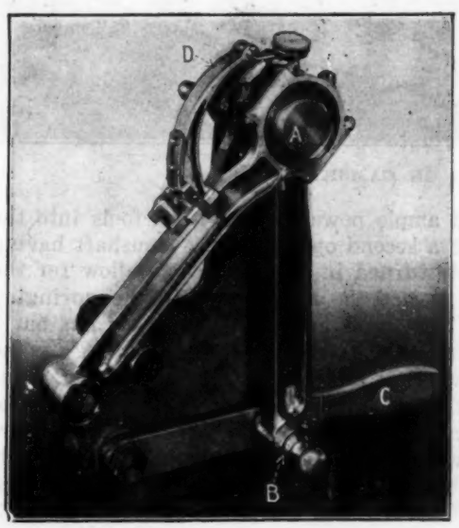
FIG. 4. TESTING SIDE CLEARANCE OF CONNECTING-ROD

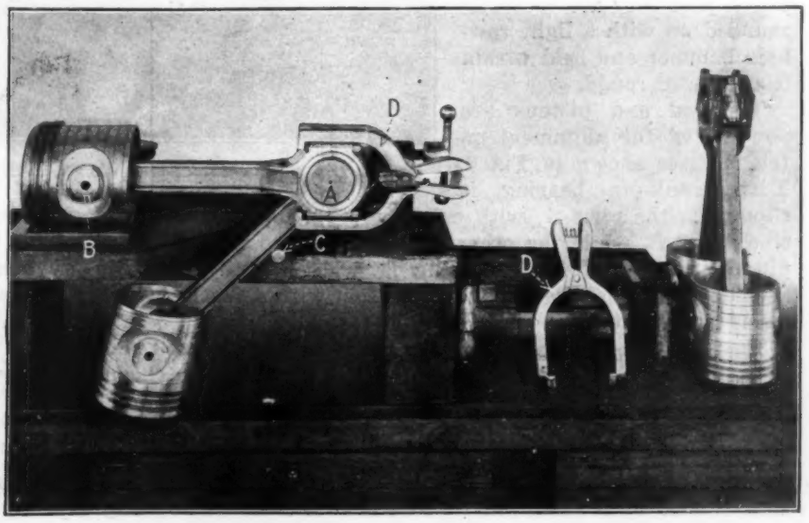
The rod is then swung through 180 deg., using the rod itself for this purpose, and cutters fed in until the bearing is exactly the required dimension. The cutters must be perfectly sharp to prevent chatter marks. The production is 350 pieces in 9 hr. by one man.

Next comes the fitting of the rods to the crank-pin bearings, Fig. 4. A set of six rods is selected with crank-pin bearings reamed to the same dimensions, and a crankshaft selected with crank pin of suitable dimensions to give the necessary clearance between pin and bearings. The shaft is held on the blocks as shown, the rod being assembled to the shaft with the letter R toward the assembler. A tool with a dial gage is fastened to the check of the crankshaft so that the indicator button touches the bearing. The rod is then turned on the crank pin to ascertain the amount of clearance between pin and bearing which should be from 0.0025 to 0.0035 in. If there is insufficient clearance, the bearing may be scraped. The clearance on each rod and the number of the crankshaft are marked on a special card which is kept with the rods until they are assembled in the engine. Each bearing is also tested for side play, from 0.008 to 0.020 in. being allowed between the side of the bearing and the check of the shaft. Rods are then numbered from 1 to 6, starting from the gear end. The rods are now removed from the shaft and placed in a box with the record card, and the crankshaft submitted for acceptance. The production is 14 sets in 9 hr. by one man.

After the large crank-pin bearing of the single rod has been ground, the tap is removed and the corners of the joints carefully gone over with an oil stone to remove any burrs or sharp edges which may have been thrown up in grinding. This removes any possibility of cutting the bronze bearing which surrounds the crank pin and has well repaid the time taken.

For assembling the single and forked rods together, the fixture, shown in Fig. 5, is used. Single rods are selected which do not vary in weight more than ¼ oz. and the caps removed. The crank-pin bearing is in the forked rod and fits on an expansion arbor *A* while the small end of the single rod is slipped over another expansion arbor *B*, located in the lever *C*. This arm is then raised until a spring plunger, which passes through the arbor, springs into its proper location on the fixture, and brings the rods into their correct





FIGS. 5 AND 6. TESTING CLEARANCE OF A PLAIN ROD, AND TESTING THE ALIGNMENT OF PISTON AND ROD

AUTOMOTIVE CONSTRUCTION

relative position. Then the top of the single rod is bolted into place over the crank-pin bearing and the clearance between the sides of the single and forked rods measured with feelers, the limits being 0.004 to 0.010 in.

Then the indicator *D*, which carries the dial indicator, is clamped to the forked rod so that the indicator button catches the top of the single rod. The arm *C* is then moved up and down, and the amount of clearance between the bearing on the single rod and the outside of the crank-pin bearing is carefully noted. The limits for this are 0.0045 to 0.006 in. The assembled rods are then placed together in a box with the diameter clearance marked on a card which follows the rods to the assembling department. The production is 14 sets in 9 hr. by one man.

The rods are now washed in kerosene, dried with an air jet, and are then ready for final assembly.

The pistons are burred with a file on the inside and the outside of piston-pin hole and boss, including the corners of the retainer slot. The piston rings are burred where the ring is split. Both pistons and rings are then washed, plain boiling water being used for the pistons which are of aluminum, and hot soda water for the rings.

In assembling the rings on the pistons, a ring with a left-hand slot is placed in the center, with a right-hand ring on each side. The rings must drop in the slot of their own weight. Pistons are then weighed and made up in sets of 12.

The pistons are next placed in position and the pin forced through with a light rawhide hammer, after which the retainers are also driven into position in the same way. The pistons are then measured with a micrometer, and if they have been sprung out of shape by the forcing in of the piston pins they are carefully rounded up with a light rawhide hammer and held within 0.0005 in. of round.

The rod and pistons are now tested for alignment on the fixtures shown in Fix 6. The crank-pin bearing is slipped on the pilot *A*, with one piston resting on the steel plate *B*, while the other rod is supported by the pin *C*. The side of the bearing is held close to the shoulder of the pilot and held in position with a special clamp shown at *D*.

At the back of the steel plate *B* is an arm with a button on each end, the arm being located on the fixture, so that the center line of the buttons are in the center line of the bearing and touch the side of the piston at each end. Back of and touching the arm behind the button nearest the bearing, is a dial indicator held on a small pillar. The arm is fastened to a pillar by a pivot through the center on which the arm works freely.

The piston is pressed toward the arm until both buttons make contact and the indicator set at zero. The rod is now removed and reversed so that the other side of the bearing butts against the shoulder on the pilot and the test repeated. The indicator should not show more than 0.002 in. either side of zero. The clearance between the boss on the inside of the piston, and the side of the rod must be from 0.030 to 0.072 in. Both pistons are inspected in the same manner.

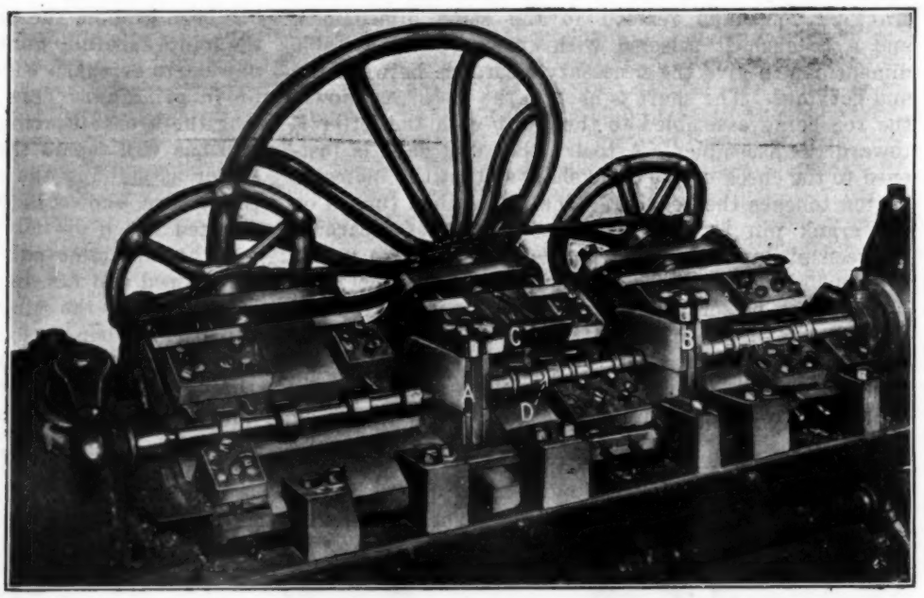
The head of the bolt which holds the piston pin must not project beyond the side of the boss, and the piston-pin retainer must be 0.006 in. below the side of the piston. This completes the rod and piston assembly.

Camshaft Set-Up

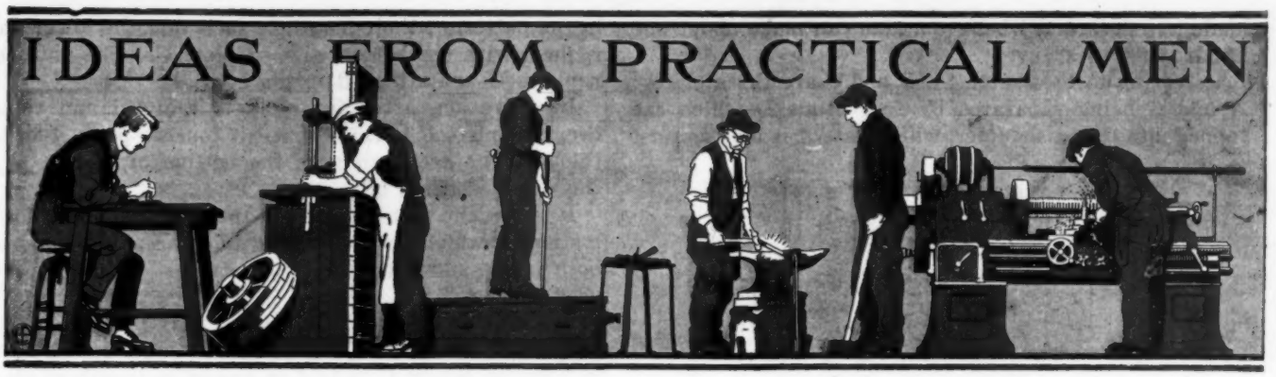
BY I. B. RICH

An excellent example of multiple tooling on the Lo-swing lathe is here illustrated, showing the practice of the H. H. Franklin Manufacturing Co., Syracuse, N. Y.

The three tool blocks are connected together by chain and sprocket, the large central wheel giving a good grip and ample power to force the tools into the work. This is a second operation, the camshaft having been previously turned in some places to allow for the steady blocks *A* and *B* which prevent the springing of the shaft. The tools are fed in and each has but a short travel as can be seen by the location of the cam. The swinging finger *C* acts as a locating guide for starting the cut, this being swung down with relation to the camshaft bearing *D* before the tools are fed into the work. This method removes stock rapidly and prepares the shaft for grinding with small machining expense.



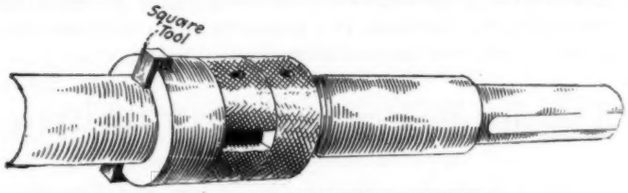
HEAVY CUTTING ON CAMSHAFTS



A Cheap and Serviceable Boring Cutter

By H. F. Kienker

The illustration shows a boring bar designed to use $\frac{3}{8}$- or $\frac{1}{2}$-in. regular square toolbits. The bar has a square hole the desired length from the end. The collar is slotted to the width of the tool used, the depth of the



MANNER OF HOLDING CUTTER

slot being about $\frac{1}{32}$ in. less than the corresponding dimension of the tool. This collar fits loosely on the bar to enable it to align itself with the tool. Two ring nuts, one acting as a locknut, serve to hold the tool in place. By increasing the size of the slotted collar larger cutters may be used.

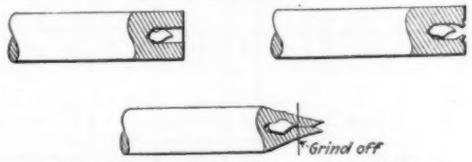
The principal idea in making this bar was to reduce the cost of cutters, the reduction when compared with the usual form being quite appreciable.

Setting Diamond for Wheel Dressing

By H. Rabezzana

In answer to the article appearing on page 407 of the *American Machinist*, I would suggest a different way to hold the diamonds. I have used this method for about 15 years with very good results.

First, drill in a mild-steel holder (carbon steel must not be used) a hole a few thousandths bigger than



METHOD OF SETTING A DIAMOND

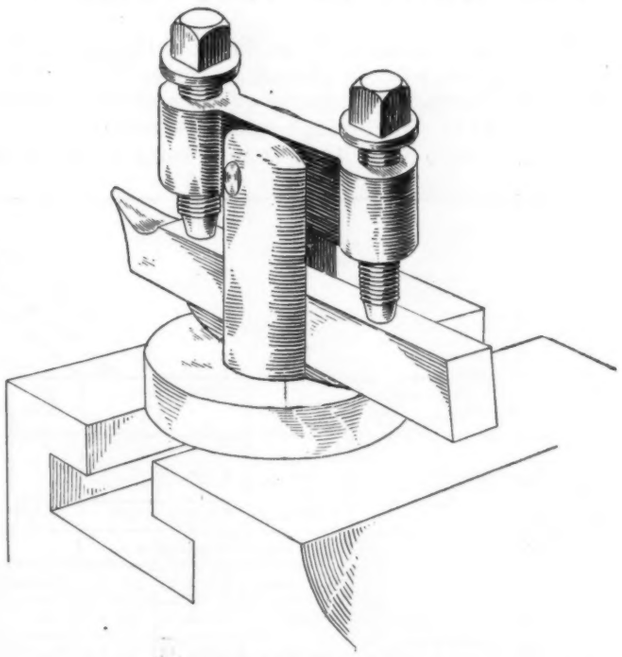
the diamond, deep enough to leave the latter $\frac{1}{16}$ in. below the surface; second, put the diamond in the hole, and with a center punch bend in the edge of the hole just enough to keep the diamond in, but leaving it free to move; third, heat the holder in a blacksmith's forge, or with a torch, to a white heat and with a small hammer close in the steel around the diamond, drawing the metal to a point. The successive stages are shown in the sketch.

Work only at very high temperature; tap lightly with the hammer. Let the holder cool slowly, and, when cold, grind off the top until the diamond is disclosed.

A Unique Toolpost

By W. W. Updegraff

This summer during my vacation, I happened to drive into a small town in Michigan, and at a garage that I visited I noticed a unique lathe toolpost which was de-



A UNIQUE TOOLPOST

signed by one of the employees. As it has a number of good features and, I think, is a decided improvement over the ordinary one-screw toolpost, I am sending a sketch of it trusting it may be of interest to some of your readers.

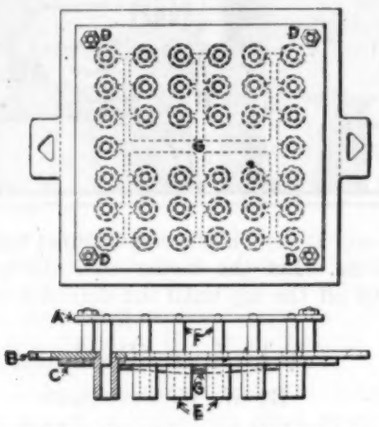
Stripping Plate for Small Collar Pattern

By R. P. Deane

The following is a description of a method of casting the small collars used as spacers between the bars of sidewalk gratings. It is used with a 12 x 12-in. snap flask and molded by hand, although the same idea could be used in a foundry equipped with molding machines to even better advantage. Thirty-eight collars are

made to a flask and I believe a man can make about one hundred flasks a day.

Referring to the sketch, *A*, *B* and *C* are three plates; *A* and *C* being separated by four studs *D* which are tapped into *C* to a shoulder, while plate *A* is held against



STRIPPING PLATE FOR MOLDING SMALL COLLARS

the other shoulder by nuts. Plate *B* is a sliding fit on the studs.

The patterns *E* are made as shown in the section, being forced into holes in plate *B* as far as the shoulder. Plate *C* is drilled the full size of the patterns allowing the patterns to slide through same. A series of pins *F* are riveted into plate *A*, these pins being a sliding fit in the patterns; their length is such that the lower end is flush with the bottom side of plate *C*. The gates or runners *G* are attached to plate *C*.

In operation, after the mold is rammed and rolled over, the plate *B* is raised until it touches plate *A* when the patterns are flush with the bottom of plate *C* and the whole is lifted off.

It is evident that plate *C* and the pins in plate *A* form a stripper which keeps the sand from breaking away on both inside and outside of the patterns. A flat cope is used.

Plates *A* and *C* are made smaller than plate *B* so that when prepared for molding the whole device can be hung in a frame, where it is held by the extra length of plate *B*, allowing plate *A* to fall by gravity to the relative (though inverted) position shown in the sketch. Thus, when the mold is rolled over the device is ready for drawing, and when placed in the frame it automatically returns to the molding position.

As the spacers are used in different lengths, the patterns are made for the longest, and when shorter ones are desired, pieces are laid between plates *B* and *C* before molding to allow the patterns to project through plate *C* only the desired distance.

Data for the Design of Jigs and Fixtures

BY ADOLPH MOSES

Any one who has had to design jigs and fixtures to be used on milling, drilling and other machines will appreciate the usefulness of the accompanying data

MANUFACTURER	NO. or SIZE	TYPE	DRAWING NO.	Max. Dist. Spindle to Column			Table to Spindle Distance		Base to Spindle Distance			No. of Morse Taper in Spindle	WORKING SURFACE OF	
					MAX.	MIN.	MAX.	MIN.		Spindle Feed	Movement of Head in Sp. Line		TABLE	BASE
Giddings & Lewis	#0	Horizontal Boring Mill	Y-105-17											
Moline		8 Spindle	Y-104-9	8-3/8	27-1/8	0	-			17-1/4	4		12-1/4 x 64	
W.F & J. Barnes	#1	Horizontal	Y-104-10	-	-	-	-		13-3/8	-	4		24-3/16 x 66-1/4	
Baker	#140	F. Column	Y-104-11	12-1/8	38-3/8	1-7/8	-		15	-	5		17 x 23-1/4	
American	3 ft.	Radial	Y-104-12	36	51	0	49	9-1/8	12-3/8	27-1/2	4		15-3/4 x 22-1/4	24-1/2 x 37
American	3 ft.	Radial	Y-104-13	38+1/4	34-1/2	4-1/4	-	-	6	9-1/4	2		20-1/4 x 33-3/8	
Mueller		Radial	Y-104-14	-	-	-	-	-		-	-			
Rockford	14 in.	R. Column	Y-104-15	7-1/8	32-3/4	0	-	-	6-1/8	6-3/8	2		11 x 11	
Hoefer	28 in.	R. Column	Y-104-16	-	-	-	-	-		-	-			
Davis	20 in.	R. Column	Y-104-17	10-1/4	26-5/8	0	41-1/4	33	8-1/4	-	3		17 Dia.	15 x 15
W.F. & J. Barnes	20 in.	R. Column	Y-104-18	10	28	2-5/8	41-1/4	32-1/4	9	-	3		16-3/16 Dia.	14-3/4 x 15-1/2
W.F. & J. Barnes	22 in.	R. Column	Y-104-20		-	-	-	-			-			
Sipp	8 in.	F. Column	Y-104-21	8	26-1/2	1	-	-	5-1/8	3 7/8	2		18 x 18-3/4	
Excelsior	15 in.	R. Column	Y-104-23	7-1/2	12	2	29	6	5-1/8	9-1/2	1		10-7/8 x 11	9-1/2 Dia.
Dwight Slate	7 in.	4 Spindle	Y-104-24	7	36-1/2	1/8	-	-	2-7/8	12-7/8	1		12-1/2 x 33	
Avery	#1/2	Bench	Y-104-25	6-7/8	-	-	11	4-1/2	2-1/2	4	-			12 x 13
Fyers	9-1/2 in.	Bench	Y-104-26	4-3/4	9-3/4	3-1/8	-	-	1-3/4	-	-		8 Dia.	-
De Moor	#22	Bench	Y-104-27	7-3/8	11	0	-	-	3-5/8	-	-		11 x 16	-

FIG. 1. DATA SHEET OF DRILLING MACHINES

MILLING MACHINE			SPINDLE		TABLE	TABLE FEEDS		DRAWING	
MAKER'S NAME	NO.	TYPE	TAPER NO.	VERT. FEED	WORKING SURFACE	LONG.	CROSS	VERT	NO.
Hendy - Norton	1-1/2	Plain H&C	10	-	10 x 32	23	8	18	Y-105-1
Cincinnati	1	Plain H&C	19	-	7-1/4 x 30-1/4	20	6-3/16	12-1/2	Y-105-2
Cooley & Edlund			11	-	8 x 36	27-1/2	-	7-1/2	Y-105-3
Browne & Sharpe	3	Universal	11	-	10 x 45-1/2	27	9-3/8	18-1/2	Y-105-6
Rockford		Universal	11	-	11-1/2 x 47-1/4	30-1/4	9-1/2	17-3/4	Y-105-7
Kearney & Trecker	1-1/2B	Vertical	10		11-1/2 x 48-1/2	38-1/2	11-7/8	15	Y-105-8
Whitney	8	Vert.Attach.	7	6-3/4	4 x 20	16-1/4	6-3/4	13	Y-105-9
Whitney	8	Hand H&C	9	6-3/4	4 x 20	16-1/4	6-3/4	13	Y-105-10
Garvin	5-1/2	Plain H&C	10	-	12 x 35	26-3/4	6-1/4	20	Y-105-12
Becker	6	Vertical	13	12-1/4	18 x 61	50-1/2	19-5/8	20-1/2	Y-105-13
Ingersoll		Lincoln	-	20-1/4	19-1/4 x 72-3/8	76	-	-	Y-105-14
U.S.Mach. Tool Co.	1	Hand H&C	9	5-7/8	4 x 23	18-1/4	6-3/8	15	Y-105-15
Kempsmith	2	Universal	10	-	6-7/8 x 35-3/4	28-3/4	8-3/4	19	Y-105-16
Giddings & Lewis	0	Hora.Bor.Mill	3M	24-1/4	23-3/4 x 45-1/2	67	30-1/2	-	Y-105-17

FIG. 2. DATA SHEET OF MILLING MACHINES

sheets and drawings. For each class of machines a data sheet is made which gives the principal specifications as well as the sizes of the machines on which the fixtures are to be used. For more detailed information reference is made to the drawing which is given the same number as given to the machine on the data sheet.

In many shops much time might be saved by making similar layouts covering the various classes of machines used and filing them away under proper headings so that information of this nature would be promptly available whenever it was needed.

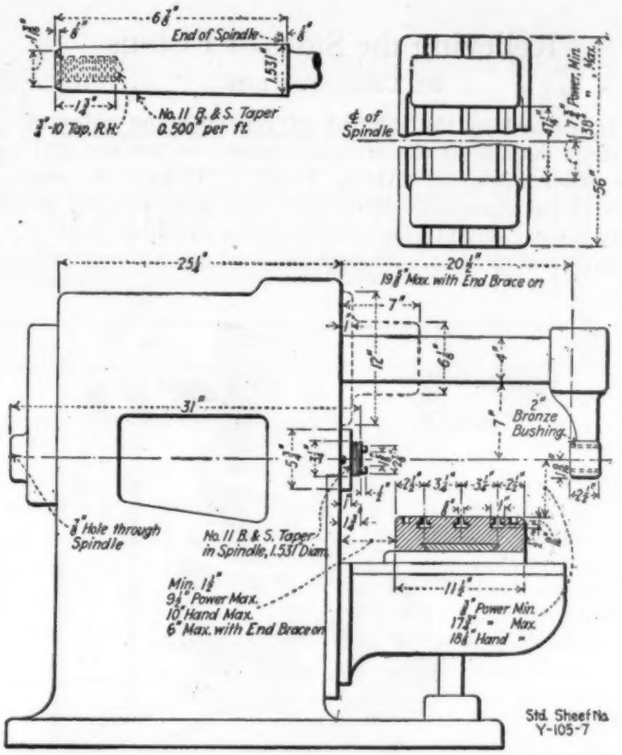

End of Spindle
No. 11 B. & S. Taper 0.500" per ft.
⅝"-10 Tap, R.H.
℄ of Spindle
Bronze Bushing
⅝" Hole through Spindle
No. 11 B. & S. Taper in Spindle, 1.531 Diam.
Min. 14" 9½" Power Max. 10" Hand Max. 6" Max. with End Brace on
Std. Sheet No. Y-105-7

FIG. 4. DIMENSIONS AND CLEARANCES ON A UNIVERSAL MILLING MACHINE

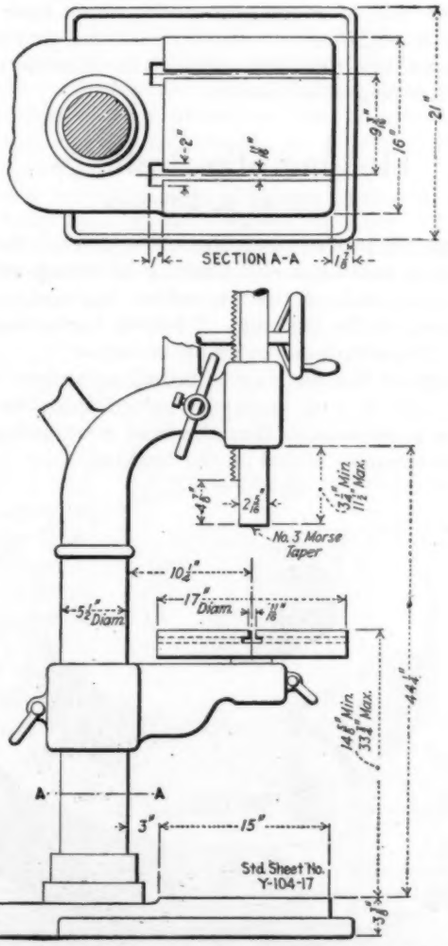


FIG. 3. DIMENSIONS AND CLEARANCES ON A DRILLING MACHINE

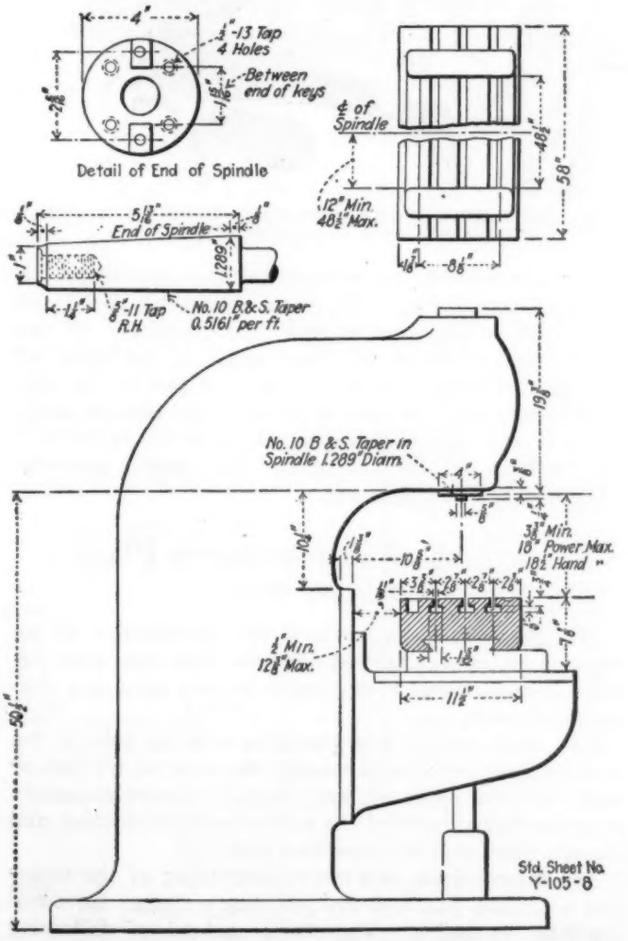
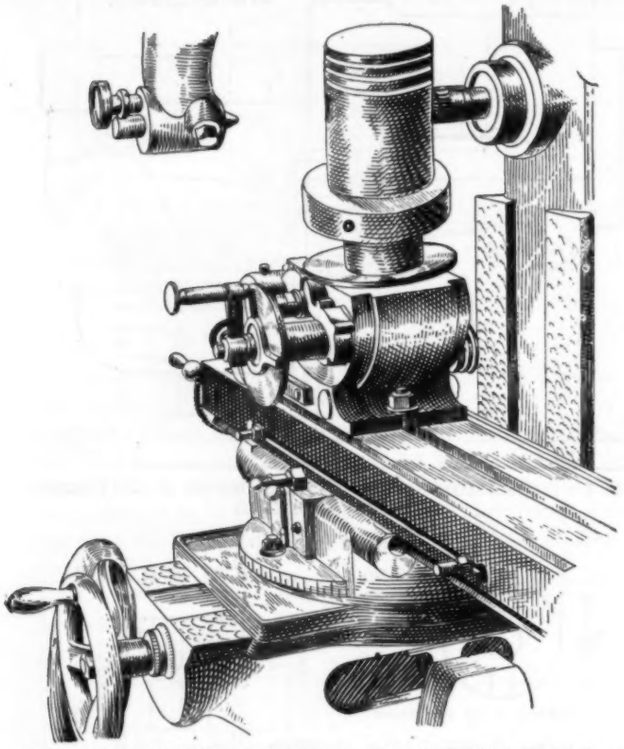

Detail of End of Spindle
End of Spindle
No. 10 B.& S. Taper 0.5161" per ft.
⅝"-11 Tap R.H.
℄ of Spindle
12" Min. 48½" Max.
No. 10 B & S. Taper in Spindle 1.289" Diam.
3¾" Min. 18" Power Max. 18½ Hand "
½" Min. 12⅞" Max.
Std. Sheet No. Y-105-8

FIG. 5. DIMENSIONS AND CLEARANCES ON A VERTICAL MILLING MACHINE

Relieving the Sides of Pistons

By Chas. F. Stotz

In regard to the method of relieving the sides of pistons outside of the wristpin bosses as per the article under the above title by Frank C. Hudson on page 368 of the *American Machinist*, I have to suggest the following: Mount the piston on the dividing head of a universal milling machine with the head set vertically



MILLING MACHINE ARRANGED FOR CUTTING CLEARANCE IN SIDES OF PISTONS

and the pin holes in line with and at the same height as the machine spindle. The head should be geared as for spiral milling and so that the periphery of the piston will revolve at the same speed as the travel of the machine table. If an end mill is put in the machine spindle and the work adjusted to the desired depth of cut it will only be necessary to feed the table back and forth to cut the clearance. The sketch herewith will show the arrangement.

Turning a Commutator in Place

By A. H. Yoch

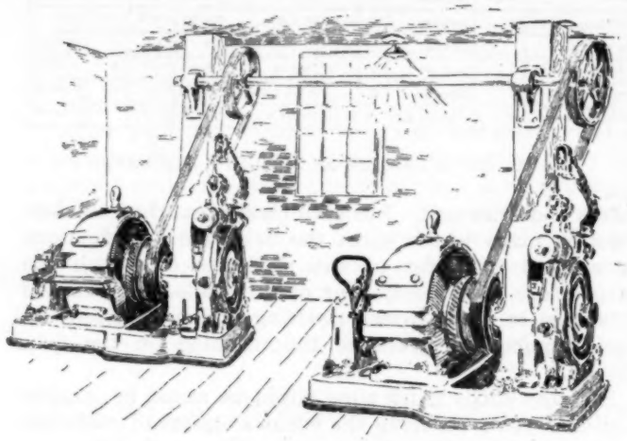
The illustration shows how the commutator of an elevator motor was turned off when that operation became necessary and it may serve to help some one similarly situated.

Two such motors were working side by side at the head of the shaft, as is usually the case where two or more cars are operated, and when it became necessary to make repairs, one of the motors was dismantled and the armature sent to a machine shop.

The taking down and the reassembling of the motor was a tedious job, and the job shop's charge for turning was excessive. Therefore, instead of following the same procedure in the case of the second motor, the scheme here described was adopted.

The cables were taken off the hoisting drums, and a countershaft put up on temporary studding erected behind the motors. Suitable pulleys were provided, the belts running directly to the drums; thus one motor could drive the other and the speed be regulated by the regular car control. The turning was accomplished by using the slide rest from a lathe, mounted upon an angle plate properly attached to the base of the motor.

The turning occupied but a short time and if the rigging had been resorted to in the first place practically all of the cost of the work on the first motor would have been saved; for, of course, the device would have served equally well regardless of which motor was driving, the only change required being that of the electric connections of the respective motors.



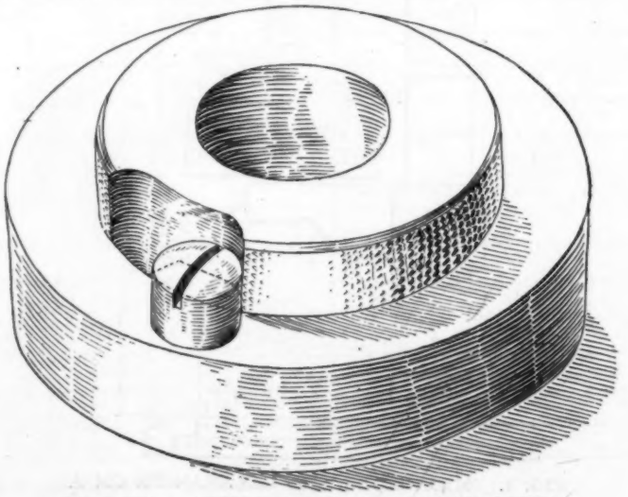
A KINK IN ELEVATOR-MOTOR REPAIR

Holding Slip Bushings

By Henry R. Bowman

On page 336 of *American Machinist* there is described a method of holding a slip bushing by means of a pin, driven in the wall of the jig, which engaged a groove in the shank of the bushing. I believe the arrangement shown in the sketch herewith to be better.

The edge of the bushing is milled as shown with an end mill, and a ¼-in. capscrew tapped into the top of the jig in such position that the head will overlap about $\frac{1}{16}$ in. the shoulder milled on the bushing.



HOLDING A SLIP BUSHING WITH CAPSCREW

U.S. ARMY ORDNANCE NEWS

A Pioneer Ordnance Machine Shop

BY H. D. PARKER
Former First Lieutenant, Ordnance Department.

Not all the hardships of the war were suffered by the men in the front-line trenches. Winter weather in other parts of France was equally bad and the construction work done by our engineers and ordnance men under such conditions is a monument to the pioneer spirit which makes the most of makeshifts.

THE building of the first machine shop at Advance Ordnance Depot No. 1, Is-Sur-Tille, France, like the building of the first flying fields, was a job to try men's souls. As early as October, 1917, the need of extensive repair facilities had begun to be felt by the Sixteenth Engineers, Railway, who had commenced the building of the greatest storage and control center in the American zone. Here was to be located Advance Ordnance Depot No. 1. To facilitate its construction, and also to help the engineers until its capacity should be required for ordnance work entirely, it was decided that a temporary shop should be put in operation at that place as quickly as possible, to be equipped with such machinery as was immediately available.

On Nov. 4 the writer was ordered to proceed to this place, at that time officially known as Army Post Office No. 712, to make the necessary arrangements with the commanding officer of the Sixteenth Engineers, Col. H. E. Burgess, and to install this proposed temporary repair shop. En route to Is-Sur-Tille it was necessary to change trains at Chandelery (near Troyes). The Austrian break-through on the Italian front had but just taken place and for hours the passenger trains were held at that junction while, in a seemingly endless procession, crowded French troop trains went roaring south, each with its flat cars loaded with artillery, field kitchens, ambulances, and battery wagons, carrying aid to the hard-pressed Italians. At last the passenger trains were released and the little station of Is-Sur-Tille was reached in the evening dusk of Nov. 4. After a night spent at the tavern, "Misset," the writer—hereafter called the ordnance officer—made his way to Camp Williams, as the Sixteenth Engineers, Railway, had named their location, and reported to Colonel Burgess. The negotiations with the Colonel were quickly over; the Engineers gave the southern end of the only available building, the quartermaster's supply storage shack, for the housing of the shop. All their facilities which would be of aid in its installation (some mixed lumber, a block and fall, some jacks and crow-bars, and boundless good-will) were placed at the disposal of the Ordnance Department. A tent was given to the officer for his quarters, and a place was also made for him at their mess.

In the afternoon a survey of the shop site was not very encouraging. The building was built with unbarked young pine trees about 4 in. in diameter for uprights and roof trusses. It was walled with newly made adobe and roofed with straw thatch. Although perfectly strong and satisfactory for the object for which it was erected, to protect the Quartermaster's stores from the winter weather, it was of such construction that neither could shafting be hung, nor running machinery be placed touching either walls or uprights. The floor was earth covered with cinders and at this time the big doorways at the unoccupied end were without doors; the cold sleet and rain were driving through them and the prospect was not cheering.

In the hope of finding something more encouraging the officer exam-

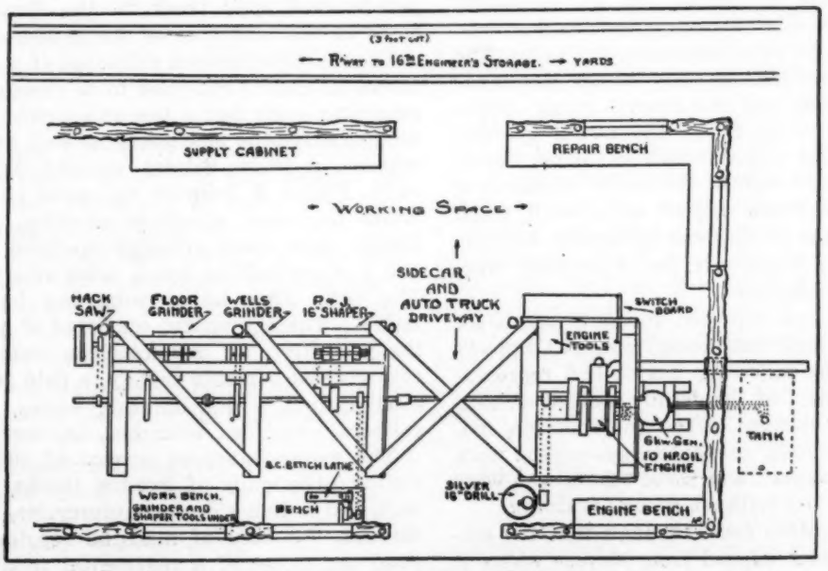


FIG. 1. LAYOUT OF TEMPORARY MACHINE SHOP

ARMY ORDNANCE NEWS

ined the pile of lumber placed at his disposal and found some 200 running feet of about 6 x 6 pine timber (all the lumber was in metric sizes, of course), about 220 ft. of what looked like beech, cut a trifle less than 2 x 6, a few pieces of pine siding and some 2 x 4's salvaged from American-made packing cases. A good quantity of spikes was available and some French lag screws of about three and six inches in length. Bolts were very scarce; a couple of dozen or so being all that could be found; but since there were plenty of nuts it was clear that bolts could be made up if, as later proved to be the case, they could not be secured in Dijon, the only large city within 75 kilometers.

Arrangements were made with the Adjutant of the Sixteenth, Lieutenant Livingstone, to quarter 11 ordnance men with the Engineer regiment, and the officer wired the Chief Ordnance Officer, Lines of Communication, Major (now Col.) Harry B. Jordan, requesting that the available machinery be shipped as arrangements for the shop were made, and for the detail of 11 men to be ordered to join the officer at the Engineers' camp.

The Storehouse

The storehouse which was to contain the temporary repair shop was located about 3 km. in a straight line from the freight yard of Is-Sur-Tille station, and about 1 km. from the nearest part of the American yards site where the Engineers were erecting warehouses and laying tracks. At this time there were no roads other than the French highways, and these did not cross the valley where the construction was being carried on. Consequently the progress of a spur track which was being laid from the American yards to the storehouse was watched with interest, since its completion before the arrival of the machinery would permit unloading at the very shop door, saving handling and the time of a long roundabout trip necessary for a heavy motor truck passing from the French yards to the camp.

During the three days following the dispatching of the telegrams to Major Jordan, the officer made himself useful to the Engineers by conducting the unloading of long trains of Decauville narrow-gage track sections. It was bitterly cold, with alternate snow and rain. The ground was of that remarkable clay which has made French porcelain famous and the French rainy season (infamous to soldiers in the field), churned it up with snow and slush to an icy mixture that was often nearly knee deep. But the men heaved the heavy tracks over the high sides of the railroad wagons with a will, much to the interest of gangs of German prisoners working nearby to whom these lately arrived Americans were clearly a source of wonderment.

On Nov. 10 the 11 men reported for duty and were quartered in separate tents but messed with A Company of the Engineers. The following trades had representatives among the 11 men of the detail: toolmaker, electrician, rigger and millwright, forge and concrete, machine erector and mechanic, carpenter, gas-engine man, mechanic and garage expert, and three others who were handy men with tools but without special training.

On Nov. 10 a notification came through that the machinery had been ordered shipped from Nevere where it had just been received and Maj. A. P. Rice, O. D. at that place, must have performed some sort of a miracle with the railroad for the notification that cars of mixed machinery had arrived at the French yards was received Nov. 11.

"Mixed machinery" described it exactly. Having been but shortly before unloaded from the ships it had, with many sorts of machinery, been sent across France as well as possible, but the great congestion of the railways during the war had naturally made it impossible during so long a journey to keep the shipment together. Consequently, the first of it that came through to Nevere did not form a balanced equipment for any shop, but had been sent on to Is-Sur-Tille as it was, to be of such use as was possible.

Going to the yards by side car the officer found four flat cars loaded with the supply. There were perhaps 20 various machines ranging from a bench lathe to a big planing machine. Obviously, some of it was not suited to the requirements of a small shop. The cars were moved to the American yards and spotted before one of the new warehouses just erected by the Engineers in which permission to store the unused machines had been granted.

Examination Discloses a 36-Ft. Line Shaft

A careful examination of the equipment brought to light the fact that there were but three lengths of line shafting, each about 12 ft. long. This automatically placed a definite limit on the shop's equipment. Lack of fore-knowledge of what was coming through had previously made it impossible to plan definitely, but now with a 36-ft. line shaft in view, a selection of the machinery which would most nearly operate the shop successfully was a simple matter.

All the machinery not desired (consisting of big gun lathes, eight-foot planing machines and a big Brown & Sharpe universal milling machine without any cutters, etc.) was at once unloaded and stored in the warehouse for use in the permanent Ordnance shop which was just being started by the Engineers. The balance was left on the cars and they were spotted by means of the just-finished spur track to the Quartermaster warehouse at the back door of the temporary shop site.

The machines chosen consisted of a 10-hp. Fairbanks-Morse oil engine equipped to be close coupled to a 6-kw. generator (this being the only power unit sent, it was used to drive the machinery as well as operate the generator), a 16-in. Silvers upright drilling machine, a 16-in. Potter & Johnson universal shaping machine, a Wells universal grinding machine, a double-wheeled Blount emery-floor grinding machine, a power hacksaw and a screw-cutting bench lathe of about 16 in. x 4 ft. The only other lathes were big back-geared engine lathes. The equipment consisted of a switchboard for the generator, an oxy-acetylene welding outfit of the two-wheeled portable variety, a field forge and tools, an electric drill, a fine outfit of scales, micrometers, and calipers, some files, wrenches, hammers and bench tools.

The motor-transport service of the Engineers, consisting principally of five-ton trucks, Dodge passenger cars, and Indian side-car motorcycles, was in a bad way through the need of machine repairs which were beyond the range of a regimental repair-equipment out-

ARMY ORDNANCE NEWS

fit. Therefore it was directly to the interest of every part of the organization to get the Ordnance shop in operation as quickly as possible and the coöperation given was perfect. In fact by the time the Ordnance officer and his eleven men had reached the shop from the warehouse, where they had been storing the machinery which was not desired, they found that the train crew had already begun to unload the shop equipment. This was on Nov. 16 on which date the shop construction was started.

The spur track was located in a cut about 3 ft. deep and 12 ft. wide and because of the nature of the strip of land between it and the shop walls only the lighter boxes could be trusted to rest there safely. The heavy machines had to be carefully jacked up (luckily the Engineers were a railroad building regiment and could furnish locomotive jacks) until even with the side of the cars—which were somewhat like a gondola model—and then let down a sloping runway which the Ordnance men constructed from the timbers given by the Engineers, by means of pipe rollers and the block and fall. After all the material was unloaded and the cars withdrawn the runway was knocked apart and used to form a roadway over the mud along the track to a point opposite the shop door and to make a trestle bridge across the railroad cut. It was a heartbreaking job getting the machinery into the shop building. To begin with it was the sort of weather only met with in that part of France during the winter. The constant rain and sleet made it impossible to keep dry even a few minutes, the ground was foot-deep mud covered with about 6 in. of snow, and the men would get so numb from the wind on their soaking clothes that constant stops for rest and thawing out were necessary; frozen ears and frost-bitten feet, hands and noses kept the doctor busy. The working of the big cases, some of which weighed over two tons, along an uneven board roadway was a hard task because of the unstable surface under the planks. When the last crate was standing on its skids on the cinders of the shop the Ordnance detachment was about done up.

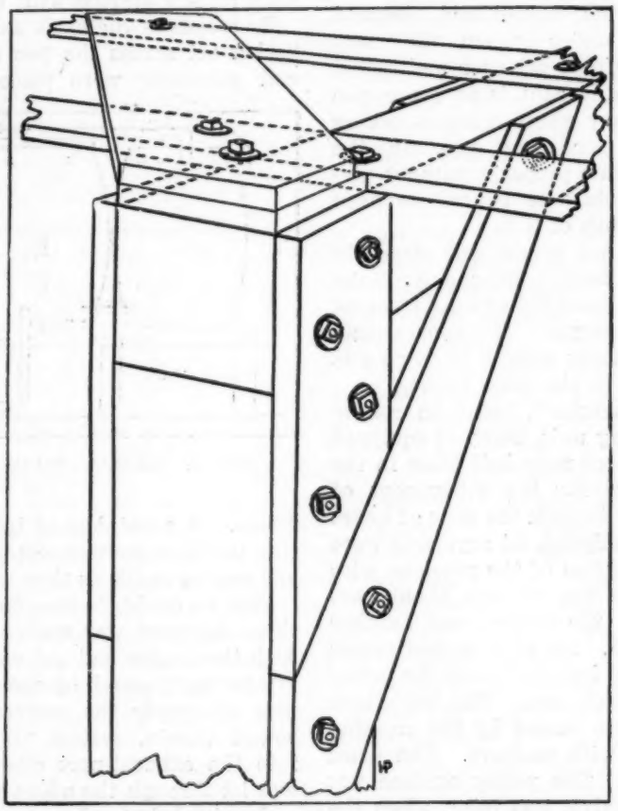


FIG. 2. TIMBERING DETAIL SHOWING COUNTERSHAFT STRINGERS

Repairs on automobiles and motorcycles had up to this time been made by the Engineers under the shelter of a shack roofed with a strip of canvas and sided with pine branches lashed to the uprights. The bitter weather made this "garage" impossible and the part of the shop marked "working space," Fig. 1, was filled with decrepit members of their motor-transport service. In order that a place for such hand repairs as were possible could be supplied, the Ordnance detachment set to work building the work bench in that corner of the shop, and then erected the big cabinet at the left of the back door in which their own equipment might be stored separate from that of the Engineers' repair gang.

This being finished the opening of the various cases and the checking of their contents against the invoice, which had just been received, was begun. The small parts, tools, etc., were placed in the cabinet and the larger part laid out in groups according to their uses.

To use the small supply of timber to the best advantage it was decided to make five inverted U-sections of the 6 x 6-in. timbers and to brace them with heavy planking, Fig. 2. The engine bay naturally was the first begun as power was the prime requirement. The storehouses being built in the field were already being filled with supplies, some of which were easily damageable by weather, and the hanging of the warehouse doors could not be effected until the door tracks were drilled. There were some two thousand feet of these door tracks requiring a $\frac{7}{16}$-in. hole every 14 in., waiting for the drill to get in operation.

Upon clearing away the cinders it was found that the earth floor was but 4 in. deep and that under that was a scaling sort of stone. Calling again upon the Engineers, rock drills and sledges were secured and the four holes needed for the engine bay timbers were drilled by two men, while the rest were cutting up and putting together the timbers (there were just bolts enough for this bay), and making the foundation for the engine and generator, Fig. 3, which had been designed as soon as their base dimensions had been ascertained. Attempts to chip the stone flat enough to receive the base proved useless as the strata were diagonal and of such loosely knit structure that large slabs would break out upon a chisel stroke. Therefore, the stone was leveled as well as possible and the under side of the main timbers of the base cut to fit. Five bolt holes were drilled in each timber and one of the men who was a blacksmith by trade began to make long anchor bolts out of some iron rod with the aid of

ARMY ORDNANCE NEWS

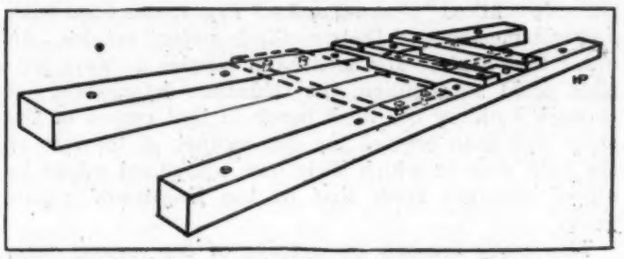


FIG. 3. ENGINE AND GENERATOR BASE

the little forge. Corresponding holes were drilled into the stone and the bolts inserted, melted lead (secured from a drain pipe acquired under system "D") was poured down about them, the base set over and bolted down. (System "D," it should be said, is an expression borrowed from the French army where it means taking something from a civilian for army use. In the A. E. F. it meant taking private property without giving a receipt.) Rich concrete was poured between the timbers to an average depth of 2 in.

The two U-sections were then raised and placed in the holes prepared for them, leveled up, and the holes filled with cement, which was protected against freezing with manure from the horse corral. The approximate measurements of these U-sections were 9 ft. wide and 10 ft. high from the bottom of the cross-timber.

The engine (with the generator), being in reality simply an electrical generating unit, was not equipped with a driving pulley; but there were bolt holes in the arms of the outside flywheel for the attachment of one. From the soft-pine boards from the ends of boxes in which canned foods were shipped, 24 segments were cut and nailed together with some of the precious wire nails. Eight bolts were then run through about two-thirds of the distance from the center, and another was placed in the center itself. An eight-armed spider was made from 2 x ¼-in. strap iron, bolted to the pulley at the center and through each arm. The variations in approach to the pulley were caused by the crossing of the arms being filled up with washers. The arms were bolted to the flywheel. The pulley surface not being either smooth or concentric was later, when the engine was being tuned up, dressed true, first with a crude turning tool resting on one of the base timbers and then with a rasp borrowed from the horseshoer's equipment. The pulley is illustrated in Fig. 4. This was the best makeshift which could be produced, but the Ordnance officer had not much faith in its ability to stand up when driving the line shaft and machinery and a duplicate was made at once to be kept in reserve for use when the first should fail. As a matter of fact the first pulley withstood every use and during the four months that the shop was in operation never gave the least trouble although often subjected to heavy shocks, especially when the engine was being started, for, there being no clutch, the line shaft and the countershaft loose pulleys started with the engine.

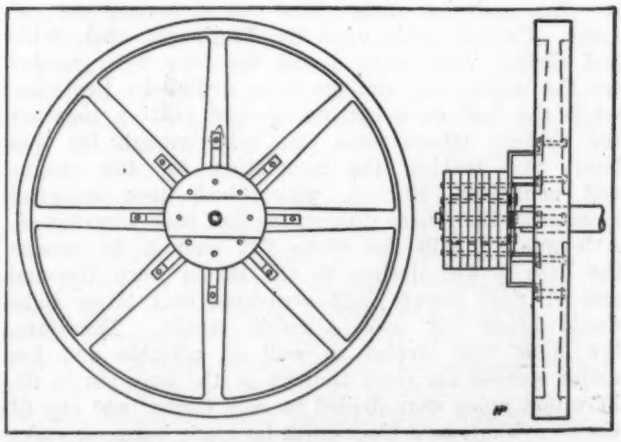


FIG. 4. MAKESHIFT WOODEN PULLEY

By means of the block and fall, in conjunction with a timber set across the two upright sections, the engine and generator were placed over their bolts on the frame. A great deal of trouble was experienced in fitting the fiber-toothed coupling connecting the generator and engine shaft, as they were not at all well mated.

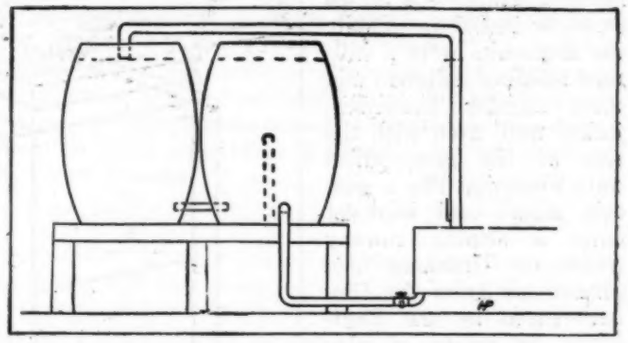


FIG. 5. THERMO-SYPHON COOLING SYSTEM FOR OIL ENGINE

Due, no doubt, to the conditions under which the machine shipment was made the exhaust piping furnished with the engine had not arrived with it and, therefore, after a day's search by one of the men, a piece of metric pipe of nearly the correct size was found and borrowed (again, system "D") which could be screwed into the exhaust-port elbow about three turns. This was let through the adobe wall inside a large drain tile and extended (underground) about 8 ft. beyond the wall into a pit which was boxed over.

This shop and storage building was burned down some time later by a fire originating at the corner of the building through which the pipe extended. An examining board decided that the fire was caused by the exhaust pipe, which was found upon examination to be so filled with carbon deposit that its passage way was but about an inch in diameter. While not doubting the correctness of this cause as found by the board, the writer is of the opinion that the fire would have more probably been caused by the light stove pipe extending through the wall about 8 ft. higher up, serving a small wood stove used for heating glue, cement and other automobile and tire-repair materials, and which was rather heavily stoked on cold days, since it was the only heat in that end of the building.

An idea of the difficulty of working in the underlying rock is gained when it is noted that it took three men two days to bury the one-barrel steel fuel tank. The supply and outflow pipe lines were found and fitted with-

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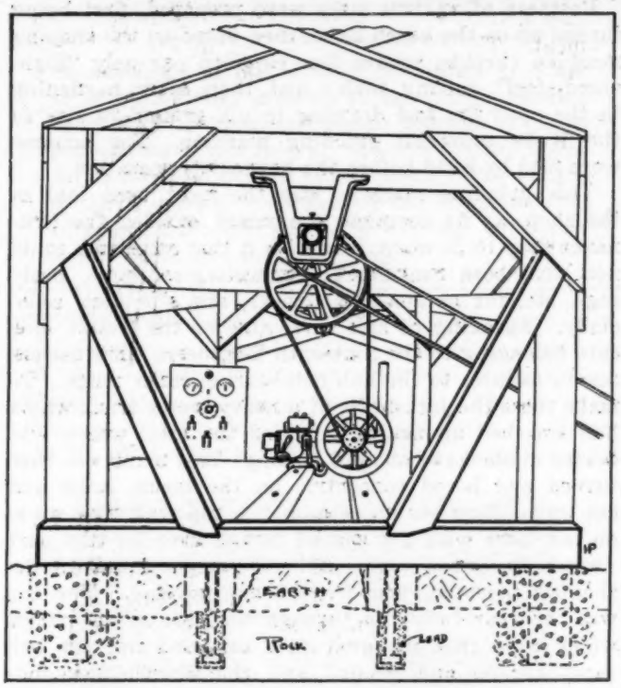


FIG. 6. CROSS-SECTION OF ENGINE BAY

out trouble, except that nothing like shellac or lead with which to make the pipe joints tight could be found. The difficulty was overcome successfully by boiling down a small quantity of army olive drab paint until it was of the consistency of thick shellac.

It was nine o'clock of the evening of Nov. 25 when the last bit of fitting about the engine was finished. A barrel of crude oil had been supplied by the Engineers and the tank filled. Kerosene for priming and to feed the starting torch had been supplied together with automobile cylinder oil (the only oil obtainable) for the lubricating system. No one had had any experience with this type of engine at all and because of the rough treatment it had sustained and the exposure it had suffered during its long trip from America, both the Ordnance officer and a private who, because of some automobile experience, had been detailed as engineer expected a lot of trouble. Every bit had been cleaned and oiled and the booklet of instructions, which in some manner had managed to stick by the engine during all its travels, had been almost learned by heart. The required starting operations were performed and the private heaved up the flywheel against the compression. In all the American expedition there were not, at that moment, two men who were more surprised, for the engine started. The governor, being set for too high a speed permitted the engine to race. It was at once shut down and the governor setting adjusted, but not before the end of the base away from the generator had become loose to the extent of ¼ in. vertical play. Three timbers of about 3 x 6 in. which had been included in the timber gift were braced across the top of the base at the end under the second U-section, as shown in Fig. 6, which held the engine firm.

Because of the pressing need for the drill to operate, the work was continued through the night of Nov. 20, and on Nov. 21 the three other U-sections were erected, braced, cemented, and the countershaft stringers placed. These last were fastened by means of the lag-screws, but for all the timber work the long bolts had to be made by hand at the little forge and threaded with a Lightning screw plate which was fortunately found among the Engineers' equipment and borrowed. Luckily there were quantities of nuts which could be used, and also plenty of washers.

THE COOLING SYSTEM FOR ENGINE

On Nov. 23 a cooling system was built for the engine which worked perfectly through the period the shop was run, although often the engine ran for 24 hr. a day. This is illustrated in Fig. 5. The casks were French wine casks holding a little more than an American barrel. The baffle plate shown in the right-hand cask did not extend more than halfway across the diameter, and simply served to divide the stream of water coming in from the left-hand cask from that being drawn through the supply pipe. The thermometer in the water pipe over the engine jacket ranged from 140 to 170 deg. F., depending on the length of run. Water to replace evaporation was poured in by buckets.

This system operated, it will be remembered, in a temperature ranging from 35 above to 15 deg. below zero, F. The intention in case the set-up must be used in summer, was to continue to add intermediate casks until the thermometer would remain at 150.

On Nov. 24 the driving pulley was attached finally to the flywheel and the entire overhead of the first bay was completed. The cooling system, then but one barrel, was connected to the engine and filled. The engine was started and run for an hour while the drive pulley was being dressed into shape. At the same time other men were locating the drilling machine in a position where it could be driven from the first bay shafting.

The drilling machine was mounted on the end of a big packing case set on the cinder floor. Two long sills of the 2 x 6's were placed to form foundations for the other machine tools; these were tied together under each machine by two filling-in blocks "toe nailed" between them, Fig. 7. The space between the stringers

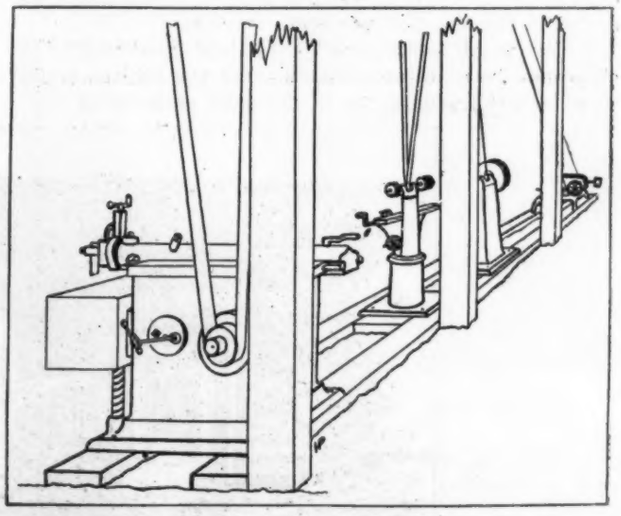


FIG. 7. LINE OF MACHINES ON TIMBER SILLS

ARMY ORDNANCE NEWS

was filled with rich cement down to the surface of the rock.

Now that the drilling machine was about ready to run it was discovered that the drills received were all Morse taper, while the machine was equipped with a chuck. It was necessary, therefore, to remove the chuck and make a Morse taper adapter of *oak* for use until the bench lathe should be in operation, when a metal one could be made. The adapter was made in less than 2 hr. and ran successfully until exchanged for the metal one made up later.

Sunday, Nov. 25, found the first bay in full operation drilling door-track strips. The bench lathe was temporarily belted off the line shaft of the first bay, being located for the moment on the auto repair bench, until a metal Morse taper adapter was made up.

The following day the switchboard supplied with the generator unit was mounted and two leads for a couple of temporary lamps were run. The men worked all day putting in the full shop running system and also building a sort of long tent of tarpaulin over the top of the entire timber structure; for a thaw had started and the thatch leaked badly.

On Nov. 27 found the other wine cask arrived and the cooling system was promptly expanded to receive it. The wiring of the switchboard was finished as well as that of the entire shop and garage repair space including plenty of sockets on walls and posts into which the electric drill or trouble lamps could be plugged. Evening found the wiring and switchboard finished and that night was the first that work did not stop at about five, with the exception of such jobs as had been done by lantern light.

On Nov. 28 all the shafting, hangers, countershafting, and machines were located and in place, pulleys mounted and everything belted up. The Ordnance officer had been in considerable doubt as to the ability of the engine to drive the load of line shafting in five hangers, four countershafts, and six machine tools in operation, in addition to the coupled generator for which it was designed. But from Nov. 30 until the shop was destroyed by fire, neither by undue heating, power delivered at the machines, nor by switchboard dial readings did the engine act other than as though it were expressly designed for the 150 per cent. overload.

A few words describing typical jobs handled by this shop may be of interest considering the limited equipment and the wide range of the calls made upon it.

Reamers of various sizes were prepared, first being turned up on the bench lathe, then fluted on the shaping machine (broken square files supplied our only "high-speed-steel" cutting tools) and then after hardening in the open fire and drawing in oil, ground to size in the Wells universal grinding machine. The squares were filed by hand before the hardening operation.

This grinding machine was the most used tool in the shop, as its complete equipment enabled the Ordnance shop to do many jobs with it that otherwise could not have been considered; connecting-rod pins, bushings, etc. for automobiles, trucks, and side cars especially. Speaking of side cars, nine of the Indian side cars belonging to the Sixteenth Engineers were useless due to failures to the hub ball-bearing inner rings. To make these the jackshafts of a heavy motor truck which had smashed up nearby supplied the steel which was drilled in blanks of about 6 in. long. This blank was then turned and bored concentric on the bench lathe and cut up to form six rings each. A tap was then made on the lathe with the special thread used on this part (which the screw plates did not carry), fluted in the shaping machine, heat-treated and ground. The tap was then carefully run through the bore of the rings, which were then mounted on a threaded rod, the ball races turned and ground and the wrench hexagons filed. They were then heat-treated in the forge, ground to finished size, polished and put to work. Forty were made, all of which fitted perfectly and of which but eight failed when put to use.

Other Miscellaneous Jobs

A lot of big cast-iron flanges for couplings on the reservoir line being laid by the Engineers came in to be faced true, which job was done on the shaping machine. The big main sprockets of a steam excavator broke and were strapped and welded. Driving and camshaft gears were made up for automobiles, the teeth being shaper cut. Optical instruments for the surveying force were repaired.

And all the time continued what might be called the "production work" of the shop; that is to say, the making of barrel pins for the steel work of the big Ordnance shop just being erected, the quantity of drilling jobs, the constant welding of small parts and, in conjunction with the garage men of the Engineers, the repair of endless rows of motor transports.

How to Save Stock in the Forge Shop

By E. T. LANHAM
Instructor in Forge Practice, University of Illinois

In small shops the method of control of stock is sometimes left entirely to the tender mercies of a stock clerk whose brains are apt to be in proportion to his salary. Results usually speak for themselves in such cases. Here is the system of stock control employed in the University of Illinois shops, and also the method by which scrap waste has been reduced.

THE preliminary work necessary to get the most efficient service out of the forge-shop stockroom must receive the closest attention. In a well-organized forge shop the equipment and small tools are presumed to be in first-class condition, and the care of all such tools and equipment, together with

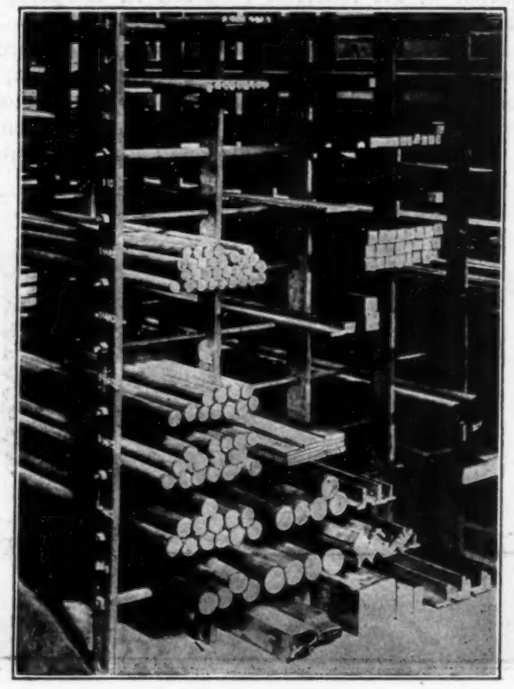


FIG. 1. STOCK STORAGE RACK

the general appearance of the shop is a problem of moment often put up to one man, the foreman or superintendent, whose sole ambition is to put his shop on a paying basis. This problem and many others equally complex are always confronting the manager of any shop whether the output be machines, engines or men.

During the past two or three years another, and equally important problem, has arisen in regard to material and its storage. With all steel and iron taken over by the War Department for the manufacture of munitions, the question of securing supplies for other activities became at once complicated and doubtful, and the question of saving became one of the leading problems with many manufacturing plants.

In the successful operation of any forge shop the stockroom control is very important as it not only saves money for the owner but permits issuing stock in the most efficient manner. The stockroom should be provided with a storage rack in which all material can be

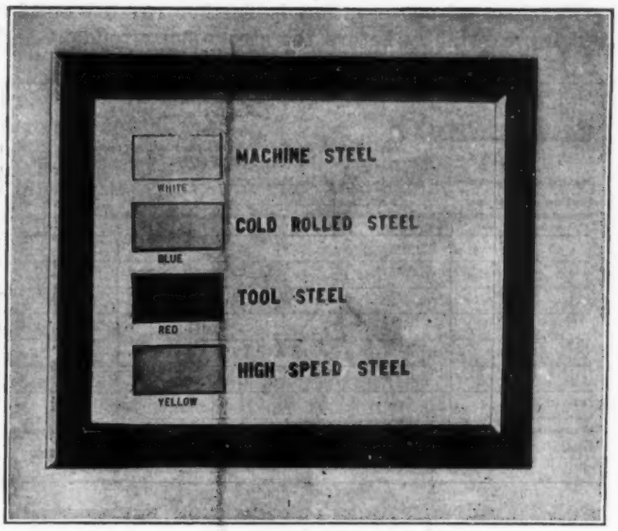


FIG. 2. COLOR CHART FOR STEEL STOCK

arranged in such a manner that anyone can tell at a glance the kind and amount of material in stock.

In Fig. 1 is illustrated a stock rack which has proved to be effective, yet cheap; the vertical bars are of cast-iron, while the crossbars are steel rods passing through short sections of pipe to aid in holding the vertical

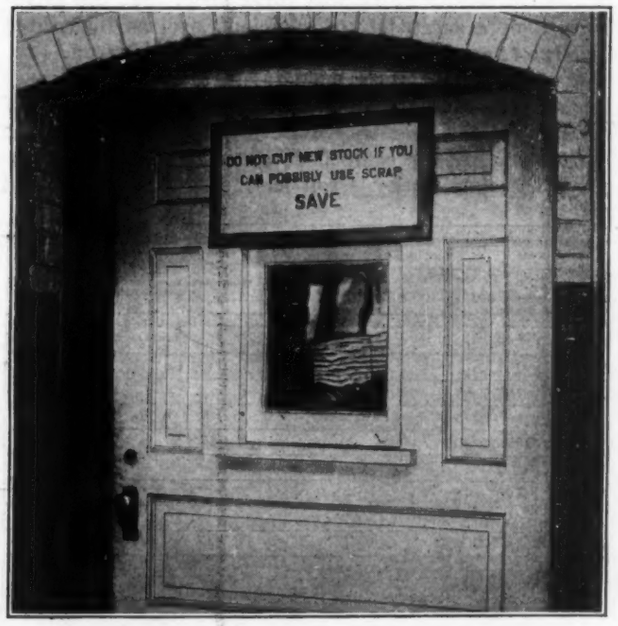


FIG. 3. A REMINDER FOR THE STOCK CLERK

bars rigid. At the side of each pocket an aluminum tag is placed which shows the size of material in that particular pocket.

To aid in distinguishing the kind or grade of steel in each pocket a color scheme was incorporated. In Fig. 2 the color chart is illustrated, consisting of a series of rectangular sections each painted a different color, these colors corresponding to the painted ends of material in the rack. To be absolutely sure the stock does not get mixed as to grade, a brush stripe of the same color may be run the entire length of the bar.

The idea of conservation is further carried out by keeping constantly before the stockroom attendant and

Department of Mechanical Engineering
University of Illinois
Shop Laboratories
Pattern, Foundry, Forge and Machine Departments
STORE ROOM

STORE REQUISITION

Material and Supplies issued on this requisition is for Job No. .....
Purchaser or Department ..... Date .....

Quantity	Size	Description	Unit Cost	Total Cost	

Make a charge for every article issued. Handle the stock like you would your cash.

Issued ..... Received by .....
Dept. of Stores
Local Address .....

FIG. 5. STORES—REQUISITION FORM

mechanics, the legend illustrated in Fig. 3. These things tend to broaden the viewpoint of the smith who is too often narrow-minded except as to his own business. Again, to stop here after inculcating the principle of saving in the shop employee, would have been mere folly. It is estimated that the average forge shop sends to the scrap pile from 10 to 15 per cent. of the material drawn from the stockroom. It has been proved in the University of Illinois forge shop, that the introduction of a scrap box of sufficient size, as illustrated in Fig. 4, encourages a saving of steel and iron.

Mechanics and their helpers are required to place therein all scrap that can be used for any number of small jobs, in this way relieving the strain on the storeroom. Being compelled to save in order to conserve the supply, the lesson has been well learned and

ORIGINAL
RECEIVING TICKET

DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY OF ILLINOIS
SHOP LABORATORIES
PATTERN, FOUNDRY, FORGE AND MACHINE DEPARTMENTS
STORE ROOM

NO. .....
RECEIVED FROM ..... DATE .....

QUANTITY	SIZE	DESCRIPTION	CLASSIFICATION NO.	CONDITION OF SHIPMENT GOOD	BAD

NOTE—Many shortages arise from goods being left in packing, or shown and sent packing. CAUTION: DEFACE WITH CARE. Attach packing list to duplicate copy and forward to Director Office.

UNPACKED AND CHECKED BY .....

FIG. 6. STORES—RECEIPT FORM

now that the War Department has released the steel to all manufacturers, the idea of saving has been so thoroughly instilled that involuntarily the scrap box has become the first-aid to the stockroom, with a consequent saving of at least 25 per cent. of the stock that at one time was relegated to the scrap pile.

However, the saving of stock is not the only important item in storeroom control. Some plan must be devised by which stock removed from the storeroom can be charged to the job for which it is used. Fig. 5 illustrates our method of control of outgoing supplies.

Store Requisition and Receiving Ticket

This requisition is used in duplicate and is printed on ordinary bond paper (white and pink), size 4 x 6 in.

When material is given out the charge is made on this requisition by the stores clerk. The original is sent to the accounting department for use in making charges, while the duplicate is filed in the storeroom for information in regard to perpetual inventory.

When material is received in the storeroom a record is made on the stores receipt, Fig. 6. The receipt is used in duplicate and is also printed on ordinary bond stock (light-green and pink), size 4 x 6 in. The original is forwarded to the accounting office and the duplicate is placed on file in the storeroom for the information of the material assistant in compiling the perpetual inventory.

A perpetual inventory is kept on plain-ruled cards of four different colors, white, blue, red and yellow, corresponding to the colors on the color chart. As stock is issued from the storeroom a record is made on the card corresponding to the size and kind of material

FIG. 4. THE STEEL SCRAP BOX

used. Thus if we had 250 ft. of a certain size of stock on hand and issued 15 ft., the record would show a balance of 235 ft.

From information furnished by the stores-receipt duplicate, all material is entered on the perpetual inventory file, together with the date of issuance. As all records are kept up to date by the clerk in charge of the storeroom, clerical work is reduced to the minimum and the workman relieved of any responsibility in regard to the charging of stores.

What Is a High-Grade Machine?

By Alfred Trosch
Betts Machine Company

We understand a high-grade machine to be one which embodies the following requirements: Correct design, best material, first-class workmanship and accuracy.

A Chance to Show Where You Stand

WE HAVE never indulged to any great extent in that favorite pastime of political orators, waving the American flag. So far as we are concerned it has three colors—red, white and blue—and any attempt to alter this arrangement by force will be met by the strongest resistance we can offer.

When the time comes for the elimination of the blue and the white from the standard under which we have prospered for so many years, we hope that we will have gone where all good editors go.

The Department of Justice has collected incontrovertible evidence of the existence of a sinister and well-organized plot to overthrow our Government by violence. The Attorney-General has also reported that no legislation except emergency war measures existed under which he could proceed against the instigators.

Existing solely for the dispensing of information, we naturally believe in the freedom of the press and in free speech, but there is a difference between liberty and license and we believe in recognizing it. The spread of sedition by any spoken or printed word is an abuse of the liberty permitted by our laws.

Bolshevism in Russia was started in just this way but without nearly the facilities for the rapid spread of inflammatory propaganda that have been permitted by our lax laws and complacent procrastination.

In bidding farewell to our too-hospitable shores, Emma Goldman and Alexander Berkman predicted a revolution within five years and their return to organize "soviet America"! Have we let our civilization be undermined to that extent? We use the term civilization advisedly, for Bolshevism and civilization as we know it cannot exist together.

Any system that deliberately takes small children from their parents, carefully destroys every possible clue to their identity, removes them in cattle cars to secluded communities and there proceeds to eliminate all traces of religion, family ties and affections, and morality as we understand it, is the direct antithesis of the democratic principles upon which our republic is founded. Yet that is what we are facing.

To silence the apostles of this deadly creed and crush the revolt before it gains momentum, the Department of Justice has drawn a bill which has been introduced in the House as the Davey Sedition Bill, H. R. 10650.

The full text of the bill follows. It has teeth and should be acted upon at once. You can do your part by writing to your Congressman urging its immediate passage. Don't delay!

The Davey Sedition Bill

Defining sedition, the promoting thereof, providing punishment therefor, and for other purposes:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SEDITION.

Whoever, with the intent to levy war against the United States, or to cause the change, overthrow, or destruction of the Government or of any of the laws or authority thereof, or to cause the overthrow or destruction of all forms of law or organized government, or to oppose, prevent, hinder, or delay the execution of any law of the United States, or the free performance by the United States Government or any one of its officers, agents, or employees of its or his public duty, commits, or attempts or threatens to commit, any act of force against any person or any property, or any act of terrorism, hate, revenge, or injury against the person or property of any officer, agent, or employee of the United States, shall be deemed guilty of sedition, and, upon conviction thereof, shall be punished by a fine not exceeding $10,000, or by imprisonment for a period not exceeding twenty years, or by both such fine and imprisonment, in the discretion of the court.

Sec. 2. Promoting Sedition.—Whoever makes, displays, writes, prints, or circulates, or knowingly aids or abets the making, displaying, writing, printing, or circulating of any sign, word, speech, picture, design, argument, or teaching which advises, advocates, teaches, or justifies any act of sedition as hereinbefore defined, or any act which tends to incite sedition as hereinbefore defined, or organizes or assists, or joins in the organization of, or becomes or remains a member of, or affiliated with, any society or organization, whether the same be formally organized or not, which has for its object, in whole or in part, the advising, advocating, teaching, or justifying of any act of sedition as hereinbefore defined, or the inciting of sedition as hereinbefore defined, shall be deemed guilty of promoting sedition, and, upon conviction thereof, shall be punished by a fine of not exceeding $10,000, or by imprisonment of not exceeding ten years, or by both such fine and imprisonment, in the discretion of the court.

Sec. 3. Aliens to Be Deported.—Any alien who shall be convicted under any of the provisions of this Act shall, at the expiration of his sentence, be taken into custody under the warrant of the Secretary of Labor and deported in the manner provided by the immigration laws of the United States then in force, and said alien shall forever thereafter be debarred from again entering the United States or any Territory or possession thereof.

Sec. 4. Denaturalization and Subsequent Deportation.—The conviction under any of the provisions of this Act of any naturalized citizen shall be deemed sufficient to authorize the cancellation of his or her certificate of naturalization in the manner provided by Section 15 of the Naturalization Act of June 29, 1906. It shall be the duty of the United States attorney in the district where said naturalized citizen is held in custody or resides to institute and conduct such proceedings immediately upon the entry of final judgment of conviction. Upon the cancellation of the certificate of naturalization the alien shall become subject to the provisions of Section 20 of this Act.

Sec. 5. The Department of Justice shall furnish the Secretary of Labor such data as will enable him at the proper time to effect the deportation of those made subject thereto by the provisions of this Act.

Electric Furnace as an Adjunct to the Cupola*

By GEORGE K. ELLIOTT
The Lunkenheimer Co., Cincinnati

Although acknowledging the cupola to be a remarkably efficient and trustworthy furnace for preheating iron up to the point of melting and after that performing the fusion itself with a minimum waste of heat, the author claims that it does not rank high as a superheater of molten metal. After explaining the difficulties encountered in attempting to superheat iron in a cupola, he points out the advantages of attaining high temperatures in melting, and states why he believes the electric furnace is the ideal supplement to the cupola. He discusses the electric furnace as a refiner, and explains how sulphur may be reduced to a low figure. He also comments upon the loss of manganese.

THIS paper is a sequel to one read by the author before the American Electrochemical Society last April. In that paper, entitled "Improving the Quality of Gray Iron by the Electric Furnace," the author described a duplex process for making gray iron suitable for the demands of modern engineering for super-grades of iron castings. The duplex process described was one installed at the plant of the Lunkenheimer Co. at Cincinnati, where it has been in successful operation for a number of months. The process consists simply of using in tandem the ordinary foundry cupola and the arc electric furnace. The purpose of the present paper is to reëmphasize the significant fact that cast iron as it comes from the cupola furnace has serious limitations that are being brought to light by the more extreme demands of modern engineering progress, and that the arc electric furnace is a competent supplement to the cupola for producing cast iron of superior quality.

Before proceeding into his subject, the author desires to make it plain beyond all possibility of misunderstanding, that his attitude toward the cupola furnace is not one of hostility nor is his criticism destructive. On the other hand, he is decidedly friendly to the cupola and his intentions are entirely constructive and calculated to be helpful and coöperative. He would not have it even suspected that the cupola is losing its long and honorable prestige, because, in truth, he knows there is no reason why it cannot continue indefinitely to be what it always has been, the most serviceable melting furnace known to foundry practice. For the ordinary run of iron castings, comprising possibly 90 per cent. of the total output, there is no valid economical reason for either displacing or radically modifying the modern cupola. It is a noteworthy success in its accustomed field. It is only here and there in engineering, probably scattered throughout all its many branches, that we find the advanced ideas of the designing engineer not adequately matched by the best product of the iron foundry.

The result of this gradual unveiling of apparent disability in some iron castings is that the material itself is receiving a growing amount of arraignment and rebuff which we see clearly reflected in the tendency of certain specifications to pass over cast iron and seek malleable or steel castings. Far be it from us to say that some of these cases are not entirely justified by the intended service, but we do venture the opinion that in very many of them, gray cast iron as it is at its best, is preferable to the substitutes demanded. There is in gray cast iron a certain maximum worth and definite characteristics that are seldom developed to the fullest extent in the average iron foundry. We refer to the super-qualities of our best grades of pig iron, when melted, refined, superheated and cast by the best possible methods. In other words, cast iron when done full justice in the foundry, is a much better metal than even its best friends are accustomed to proclaim.

We believe that the average modern iron foundry is making castings that realize the best that is possible to their equipment but not the best that is possible to the iron itself. Foundry equipment, therefore, is at fault in its failure to realize all the innate worth of cast iron; and not the least offender is the cupola furnace. The function of the cupola is to deliver iron molten and ready for the molds, and this it does, economically, with great regularity, and continuously as long as wanted. It is a wonderful foundry servant but like its human parallels, it has sharp limitations.

Melting Efficiency of Furnaces

Whatever its faults may be, it must be acknowledged that for preheating iron up to the point of melting, and after that performing the fusion itself with a minimum waste of heat, the cupola stands supreme among the established foundry furnaces. Its melting efficiency approximately is 40 per cent. although in the hands of the unskilled it may fall as low as 25 per cent., while the adept may drive it along at a rate of as high as 50 per cent. efficiency. Counter to this we have an average efficiency of about 12 per cent. in the reverberatory or air furnace, and of about 25 per cent. in the openhearth regenerative furnace.

Although the cupola is practically without rival as a preheater and melter it does not attain high rank as a superheater of molten metal. It never fails to melt iron, but at times it fails to superheat sufficiently for the best results. In many cases, the super-grades of castings referred to in this paper, demand very hot iron; in fact, iron hotter than seems to be uniformly possible in the cupola. However, in many instances the cupola is in the hands of extremely clever experienced and intelligent masters who, by taking advantage of every circumstance of furnace, fuel and iron, succeed, to a limited but quite remarkable degree, in forcing the cupola to do what it constitutionally is not fitted to do—to produce molten iron with a fairly high degree of superheat.

The cupola operator's problem in obtaining superheated iron is largely one of circumventing gravitation as manifested in the speedy dripping of the molten iron through and away from the hottest zone of the cupola, and it seems to the author that this is the chief cause of the furnace's inability as a superheater. It removes

*Abstract of a paper presented at the annual convention of the American Foundrymen's Association, Philadelphia, Penn., Sept. 29, 1919.

the iron, once it is melted, too rapidly from the zone of maximum heat; it curtails the time available for heating and robs the liquid iron of its best opportunity for acquiring a large degree of superheat.

In the two-step process that has been described, all responsibility for superheating is taken from the cupola and assigned to the electric furnace, where with the greatest ease the iron can be superheated to a degree that is not possible in any other kind of furnace. Temperatures possible in the arc electric furnace which is recommended for this process are limited only by the melting point of the refractory lining. By this we do not intend to intimate that the higher temperatures available in the electric furnace are to be sought for cast iron, as this is far from the truth. Attaining them would be a sad waste of power with no recompensing advantage. In general, an additional one hundred or one hundred and fifty deg. F. over its cupola-given temperature is all that is necessary for gray iron.

The most apparent advantages accruing from extra hot iron are those having to do with the perfect running out or reproducing the impressions in the mold. Castings of thin section and large general dimensions are important in this consideration. Many castings of this kind are made of high-phosphorus iron merely because of the increased fluidity obtainable only through excess of phosphorus. This practice is followed in spite of the fact that phosphorus detracts substantially from the strength of the castings, reducing especially their ability to resist shock and vibration. Superheating in the electric furnace enables the foundryman to make these castings of low-phosphorus iron because he can safely shift the responsibility for fluidity from the material to the furnace. The possibility of casting strong tough irons in thin sections is one of the great advantages of highly superheated metal.

Another advantage is that hot iron tends to increase solidity in castings. The close relation existing between solidity and hot pouring temperatures is not always a matter of great concern, but to some foundrymen it is, especially to those unlucky ones whose castings are put to some form of rigid test for solidity. The makers of hydraulic cylinders and valves for high-pressure steam are in this class. These men are convinced that hot iron and a low percentage of leakers on the test, are related one to the other as cause and effect.

Gray iron of common variety poured at temperatures between 2527 and 2602 deg. F., which may be classified as very hot iron, gave solid castings of close grain and maximum strength. The same iron poured at progressively lower temperatures became weaker and more open of grain in direct proportion with the decrease of the casting temperature. When poured at 2458 deg. F. and lower, liquid contraction in the form of cavities in the heavier parts were apparent, while blowholes appeared when the pouring temperature of 2376 deg. F. was passed. It also was found in these experiments that the specific gravity of the castings varied from 7.281 in the iron poured at the highest temperature to 6.936 in that poured at the lowest temperature. The high temperatures giving the best results in the experiments, are not temperatures ordinarily and consistently attained in the cupola except possibly in a few anomalous instances. On the other hand, they can be attained after only a half's superheating in the electric furnace.

Another place where electrically superheated iron is of value is in the wide field of white irons. Naturally this should have its widest application in iron suitable for malleablizing. The freezing of molten white iron before perfectly running out the molds of smaller castings, and freezing in the ladles are no infrequent occurrences. The chief cause lies in the fact that the temperature and time range of workable fluidity for white iron are much narrower than for gray iron. The fact is, the temperature of gray iron can drop nearly twice as far before freezing as it can for white iron, which means that the time available for handling white iron is about half what it is for gray iron.

The process of treating iron in the cupola cannot be extended beyond the point of melting and a certain limited amount of superheating. Any additional operation, such as refining, is entirely out of the question and can be performed only in some other kind of furnace. The cupola is not a refining furnace. However, it often happens that from the double standpoint of raw material and product, a certain amount of refining is desirable and even necessary. Refining is the principal foundation upon which is built the reputation of the electric furnace as a metallurgical apparatus, and it is truly claimed that from even the cheapest raw materials the electric furnace can produce steel of the highest quality. With no less truth, the same can be said of preparing cast iron in the electric furnace. Especially, the electric furnace is a purifying furnace and certainly it supplies the very complement that the cupola furnace most needs.

Electric Furnace as a Refiner

In considering the electric furnace in relation to refining it is preferable to consider separately the acid-lined and the basic-lined furnaces. The acid-lined furnace is simpler in operation but also much less efficacious as a refining unit. It refines entirely through maintaining a constant reducing atmosphere in contact with the metal. The refining in an acid furnace is one of deoxidation coupled with a freeing of the bath from included gases and slag. However, the acid-lined furnace is hardly to be compared with the basic for refining, and its use in a duplex process should be for plain superheating and for mixing, but not where any considerable degree of refining is desired.

One must turn to the basic-bottom electric furnace to find potentiality in refining at its greatest. The possibilities of this furnace are bounded only by economical considerations. Almost any metallurgical reaction may be conducted in it, including oxidation, reduction, dephosphorization, desulphurization, decarburization, carburization, mixing with ferroalloy, superheating, and others. The duplex process for cast iron is chiefly concerned with reduction, desulphurization and mixing.

Normally, the conditions in the electric furnace are strongly reducing and the exposure of cupola-melted iron to them seems to have a distinctly beneficial effect. Whether iron can be oxidized in the cupola under ordinary conditions is a question upon which the authorities are not all agreed nor is there unanimity of opinion as to the benefit or harm of oxygen in cast iron. Personally, the author believes a deleterious oxidation can at times occur in the cupola, and his experience strongly indicates that cupola iron thoroughly deoxidized as it is in the electric furnace, exhibits an improvement in general physical properties that is hard to account for

on any other grounds than of deoxidation. Also it is his experience that thoroughly deoxidized iron has perceptibly more life than has the untreated iron at the same temperature.

Desulphurization is an extremely satisfactory reaction when performed in the basic electric furnace. It is not only easy to perform but it takes place during the same time that the iron is being superheated, involving no extra consumption of power. Another factor tending to fit the operation into this process is the fact that desulphurization depends for its success upon maintaining reducing conditions in the furnace. The chemical reaction by which the sulphur is removed is essentially:

$$FeS + CaO + C = Fe + CaS + CO$$

From this reaction it is seen that carbon is essential to its completion and therefore the large amount of carbon in the iron, and the carbon electrodes themselves, have a most beneficial influence upon the removal of sulphur from the bath. It is understood that the necessary basic slag is present in sufficient quantity and of the proper quality.

Sulphur is unavoidable in cast iron made by the usual methods and it is the custom to pass it over as a necessary evil. If the bare truth be spoken, the only good that can be said of it is that sometimes it is of assistance to the founder in obtaining chilled castings. The damaging fact about sulphur is that whether united with iron or with manganese in the form of sulphide, it composes an insoluble, non-metallic structural component in cast iron that cannot do aught but unfavorably affect the good physical properties of the metal.

May Reduce Sulphur to Low Figure

Standard pig iron containing a maximum of 0.05 per cent. sulphur contains from 0.07 to 0.11 per cent. after coming from the cupola, the degree of contamination depending upon the quality of coke, the condition of the cupola and its accessories, and the skill and knowledge of the cupola tender. The same iron from the cupola may subsequently have its sulphur reduced to about one-third or one-fourth by 30 or 40 min. refining in a basic bottom electric furnace. The average of a great number of "duplexed" heats of gray iron was 0.088 per cent. sulphur in the melt from the cupola, while in the final product from the electric furnace the average was 0.036 per cent. As low as 0.009 per cent. sulphur in occasional heats has been produced in gray iron under everyday working conditions.

The economical side of this great power of desulphurization attracts the attention. The founder who is able to employ this process with the basic furnace immediately finds himself to a large extent emancipated from the tyranny of low-sulphur specifications in the selection of raw materials, including pig-iron, scrap and coke. According to metallurgists of the iron foundry there exists today a sulphur problem which bases its gravity upon the probability that constant melting and remelting of the iron scrap of the world is causing a steady increase in the sulphur content of iron castings made from even the smaller percentages of scrap iron. Coke also is involved and the duplex process described does not necessitate the use of low sulphur cokes which not always are easily obtained. The doors of many foundries are closed to "off" grades of pig iron because of the high sulphur content. Here the basic electric furnace is a great leveler which makes high- or low-sulphur irons almost equally acceptable.

We have said that the electric furnace step of the duplex process is particularly good for mixing. It enables a perfect mixing of the original raw materials, assuring homeogeneity in the single heat, and it facilitates the accurate duplication of results, assuring uniformity among several heats. It simplifies and insures the perfect admixing of alloys such as ferrosilicon and ferromanganese. In the case of the latter, it is especially valuable in view of the considerable loss of mangenese that is inevitable in the cupola. Under the reducing conditions prevailing in the electric furnace there is absolutely no loss of manganese. Steel scrap may be admixed in the electric furnace making attainable that carbon-diluted form of gray iron which is also known as semisteel. This method indeed produces a real alloy of gray iron and steel with the total carbon capable of the closest regulation, and the dream of the semisteel enthusiasts is realized as by no other method.

In concluding, the author would like to leave two injunctions concerning the use of the electric furnace as an adjunct to the cupola. In the first place, the duplex process just described is not intended to displace the established methods of preparing iron in the cupola for ordinary grades of iron castings; certainly, they will not bear the added cost. The process is intended, however, for those extraordinary cases where ordinary iron as produced by the ordinary process has not met the demands of the occasion and where the advantages gained justify the extra cost of production. Also, the author does not claim that the electric furnace presents an infallible cure-all. Its adoption cannot be expected to release the founder from the necessity of good foundry practice and of constant, experienced and intelligent metallurgical supervision in every department of the foundry establishment. The electric furnace is but a bit of apparatus, efficient, it is true, and in some ways almost wonderful, but it must be supplemented by human brains.

Locating Errors in Forming Dies

By E. A. Dixie

We have had a number of forming dies made in our shops and have also had a number made outside. It was found on testing out these latter that their product was not exactly as called for by the specifications. The dies themselves were apparently all right, but the work from them would vary. Occasionally a piece would come all right, but at the next stroke the work would be distorted one way, while at the following stroke it might be distorted in another way. After tinkering with the dies for some time without a great amount of success, I laid a number of strips of soft solder wire lengthwise, crosswise and diagonally on the bottom die and tripped the press. The wires were then removed one at a time and their thickness at various points measured with a micrometer. By this means it was found that the diemaker had allowed the same vertical distance for the angular surfaces as he had for the horizontally plane surfaces. That is to say, he had removed on these surfaces an amount of metal equal to the thickness of the stock, *but measured vertically* in line with the stroke of the press and not at right angles to the forming surface. This resulted in a pinching or peening of the stock at these points and in consequent distortion of the product due to this peening. The removal of a few thousandths of metal from the angular surfaces corrected the dies.

Lovejoy Special Toolholder

A late addition to the line of metal-cutting tools manufactured by the Lovejoy Tool Co., Inc., Springfield, Vt., is illustrated herewith. This tool has a positively locked inserted-cutter without interfering projections of any sort. It was designed especially for use on machines that do not conveniently permit the removal of

LOVEJOY SPECIAL NO. 51-T TOOLHOLDER

tools from the front side of the carriage, or where clustering is necessary with no overhang.

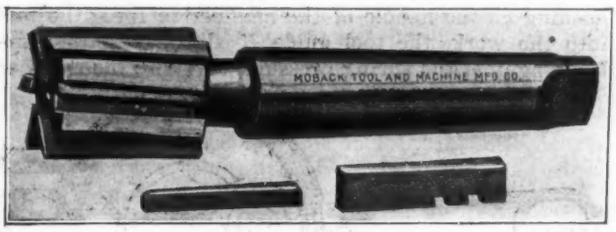
It has a shank size of approximately $1\frac{1}{8}$ x $1\frac{7}{16}$ in. A $\frac{3}{4}$-in., high-speed-steel cutter is placed in the holder at such an angle as to require very little grinding except on its end, and is pushed forward gradually to compensate for wear.

It is recommended by the makers for right-hand turning and facing, and, by a slight change in the end of the cutter, may be converted into a very efficient and serviceable planing-machine tool. In short, it may be considered as a general utility tool suitable for all ordinary jobs that a solid forged tool of equal size would be used for.

Moback Adjustable-Blade Milling Cutters

The Moback principle of cutter construction employs the use of clamping wedges to hold the blades. Each wedge has three slight tapers so placed as to produce full bearing pressure on the blades. The blades are adjustable to two cutting positions, as each is provided with two cross-slots for that purpose, as shown in the illustration. When they are worn to the end, the clamping wedges are removed and the blade is shifted to the second slot, thus doubling its life. After the blades are worn down a second time, they may be replaced by a new set, a procedure that may be continued repeatedly, as all parts are standardized. The frame is made from high-grade machinery steel, the cutters being of high-speed steel.

Three varieties of these milling cutters are made, including a complete line of end mills with diameters from $1\frac{1}{2}$ in. to $3\frac{7}{8}$ in., having numbers 9, 10, 11 and 12



MOBACK ADJUSTABLE-BLADE MILLING CUTTERS

B. & S. taper shanks; face milling cutters, 4 in. to 15 in. in diameter, and side milling cutters from 4 in. to 16 in. in diameter, right or left, with faces $1\frac{1}{4}$ in. to 3 in. in width.

This line is manufactured by the Moback Tool and Machinery Manufacturing Co., 330 Atlantic Ave., Boston, Mass.

"Titan" Pneumatic Tool

The Machine and Tool Distributing Service, 25 West Broadway, New York City, is selling agent for the "Titan" universal, single-unit, pneumatic tool illustrated.

In this device the air compressor is contained within the body of the tool itself and all piping is consequently eliminated. The complete unit without accessories is shown in Fig. 1 and will be seen to consist of tool point, hammer, flexible shaft, electric motor and connection. A section of the hammer appears in Fig. 2 from which the operating principle is evident. The body consists of two pieces *A* and *B*, screwed together, and carrying the bearings for the revolving crank *J* to which is attached the connecting-rod *K*. The piston *C* slides in the cylinder *D* and the lower end is recessed to receive the end of the floating plunger *G* and form an air cushion to

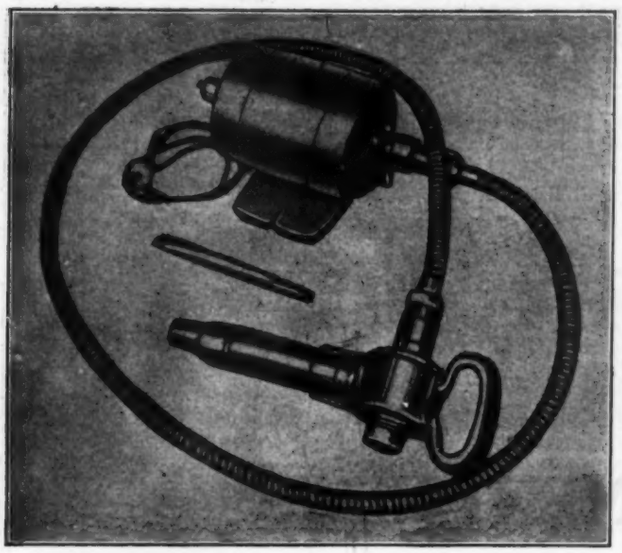


FIG. 1. TITAN UNIVERSAL PNEUMATIC TOOL

prevent a hard blow being struck on the piston on the return stroke.

When the motor is started the piston *C* is actuated by the crank and connecting-rod and reciprocates in the cylinder *D*. Owing to the fact that the ports *L* in the cylinder line up with channels in the sleeve *E* which communicate with the outside air, no appreciable change of pressure occurs and the plunger *G* is not affected. When, however, pressure is applied by the workman pushing on the handle of the hammer to force the tool into the work, the tool guide *H* slides back into the body, against the spring pressure, carrying the cylinder

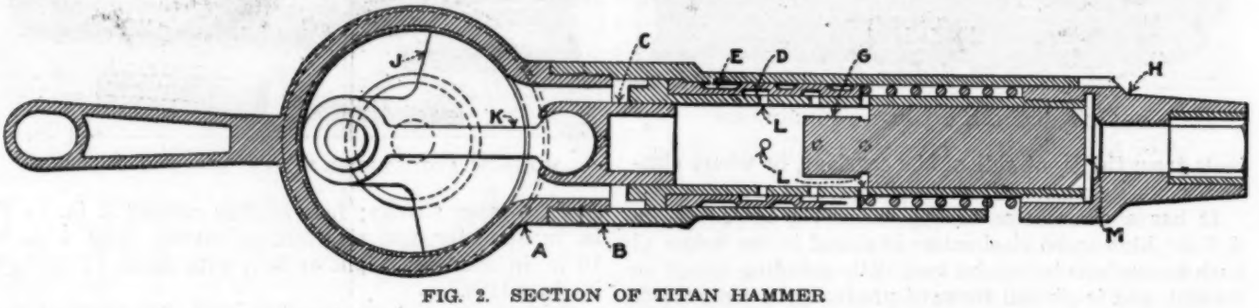


FIG. 2. SECTION OF TITAN HAMMER

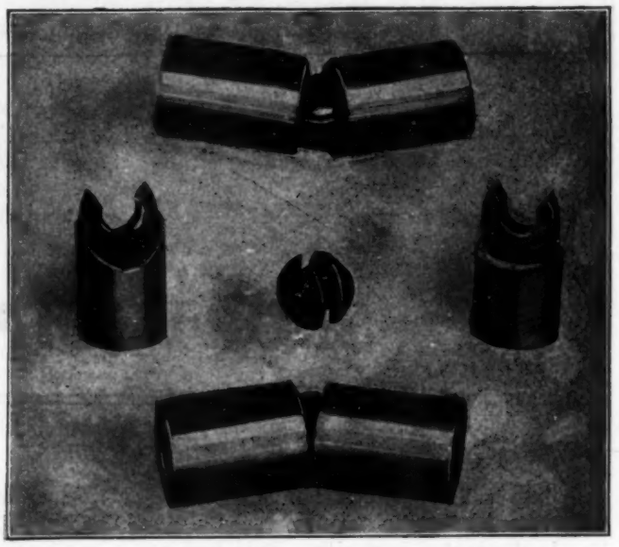
D with it and closing the ports *L*, one row after another. A slight push will close only the first row of holes and the resultant reduction of the air-passage area causes the piston to suck and push alternately with a corresponding action of the plunger. This gives only a light tap on the end of the tool. Further pressure closes more ports and increases the strength of the blow until it becomes a maximum when all ports are covered. It will be seen that the harder you push on the handle, the stronger will be the blow struck on the tool which projects through the toolholder slightly beyond the shoulder *M*.

The hammer is made in six sizes, the strength of blow ranging from a few pounds in the smallest size which is suitable for engraving and metal chasing, up to 60 lb. for the largest tool at the rate of 2000 per minute. The tool points are included with each outfit and may be selected from a wide range of strokes.

Attachments may be obtained to equip this tool for bearing and crank-case scraping, grinding, drilling and die sinking.

Fox Universal "Slip" Joint

The universal joint illustrated is manufactured by the Fox Machine Co., Jackson, Mich. It is known as a slip joint owing to the fact that it can be pushed or slipped into position where it locks itself firmly, being

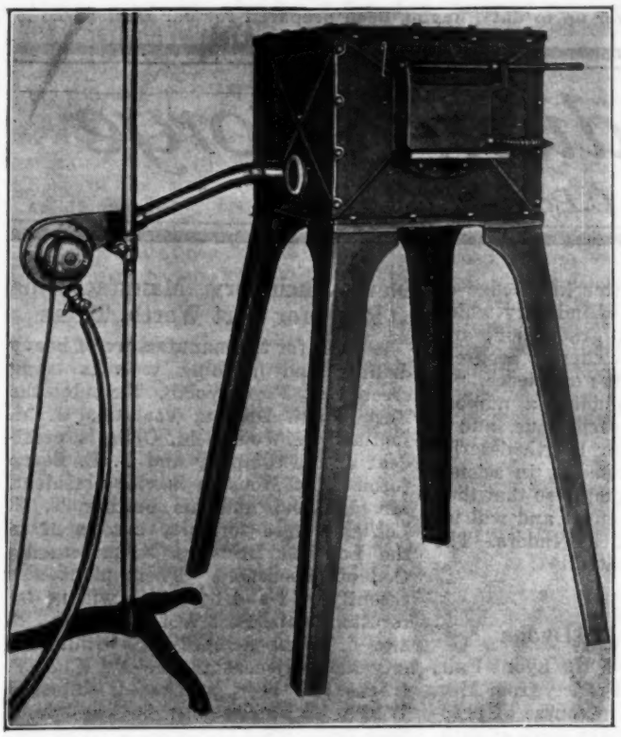


FOX UNIVERSAL "SLIP" JOINTS

driven by a key. It can also be taken off the shaft without having to take out a taper pin. This is a very desirable feature, as it is oftentimes a troublesome job to remove a taper pin where the joint is in an inaccessible place. This design provides great strength owing to the wide radius fillets taking the place of a square-cut shoulder, thus making one fork as strong as the opposite fork that has no gateway. The joint is very durable, having but three working parts that are hardened and, while intended for use on multiple-spindle drilling machines, is not limited in its application, but can be furnished for other purposes.

Combined Torch and Furnace

The North American Manufacturing Co., 5902 Carnegie Ave., Cleveland, Ohio, is furnishing as a unit its gas-electric blow torch combined with a specially built furnace. The torch is well known to the trade. It has a direct-acting motor and a flame adjustable from 3 to 24 in., with a maximum temperature of 2500 deg. F. The furnace is made of cast iron, well ribbed and is light, yet substantial, in construction. It is lined with special firebrick and insulated with asbestos. The furnace can be fired from either side when using the torch and there is a 6-in. opening in the top as a provision for



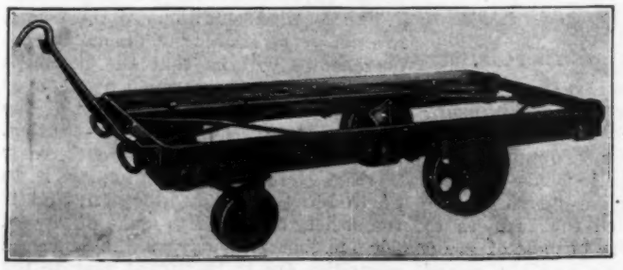
COMBINED TORCH AND FURNACE

melting various soft metals. When using for general tool-hardening, or other such work, a firebrick plug is used for the top opening. Inside dimensions of the furnace are: 10 x 10 x 10 in. The work door is 4½ x 6 in., with a hearth 10 in. deep.

W. & I. Industrial Trailer

Among the labor-saving devices used in manufacturing plants and warehouses, none is more essential than an equipment of suitable trucks. The Warren & Irrgang Co., Springfield, Mass., specialist in the manufacture of factory trucks of all types, has increased its line by the addition of several models, one of which is shown.

This trailer, known as Type WJ10, is 36 x 72 in. in size; has a height of 16 in., and is of all-steel construction. The chassis has four 3-in., 4-lb. channels running lengthwise, two for each side. The four channels are tied together with ¾- and ⅝-in. truss rods and framed with 2 x 2 x $\frac{3}{16}$-in. angle iron. The angle-iron frame has the flange up to inclose the wood platform that is securely bolted to it. The two channels at either side are used as supports for the wheels, the rear wheels passing between them, while the front wheels are of smaller diameter and arranged to swivel. The rear wheels are 14 x 3 in.; front wheels, 8½ x 2¾ in.; all running on Hyatt heavy-duty roller bearings. The large wheels are very desirable for use on uneven floors.



W. & I. INDUSTRIAL TRAILER

The truss-rod construction furnishes projecting U-bends, to which the handle is attached at the front end, the one at the rear serving as a coupler connection for another trailer. The handle is made from steel pipe and can also be used as an end rack, one additional end rack of hardwood being furnished. Stake pockets are provided at both ends and sides, and, as the racks are interchangeable, the trailer may be converted into a crate truck for handling loose materials. This type of trailer weighs 525 lb. and has a capacity of 4000 lb., but it can be furnished in any size or with any superstructure that may be desired.

Why Some Replies to Ads Are Ignored

BY GEO. W. CHILDS

The article on "Why Some Replies to Ads Are Ignored" on page 735 of the *American Machinist* is fine. The writer, like many other men in authority, has received replies to ads for help that were "birds." Of course, these never reached the files for possible future reference, but were consigned to the waste basket. The same thing holds good in replies to ads from draftsmen, or rather from men who assume the title of draftsmen. I will not take up here the subject of what in my opinion a man should be capable of doing when he applies for such a position; only to state that he should not bluff, not try to fool the "old man," but state the truth.

During the late war I had occasion, on account of our good men hastening to get on the firing line, to deal with a number of chaps running around loose, who replied by mail to ads and also had the nerve to call in person and tell me they were draftsmen. If I had not been a veteran at the game and able to look any man in the eye and tell him where to get off, I would have thrown up the sponge.

One of these perfumed fellows who go around showing their shape in hug-me-tight clothes opened my office door and gave me a sweet smile (I would rather have seen a bull dog appear). He gave, as his experience, two years on plant maintenance work; age, 22; education, high school; capabilities, could design anything necessary in a steel plant. I asked him if he knew what L-i-a-r spelled. He blushed; whereupon I rose from my seat and invited him to escape or I might get angry.

I hired one fellow who was a worthy member of the Ananias Club—I knew it, but wanted to be amused for a few days and give him a lesson. Told me he knew the game from A to Z as a machine draftsman. I gave him a job to make a detail drawing of a pair of bevel gears from a broken pair. He sat on his stool gazing out of the window, stood up and fussed around for three days. He then threw up the sponge, called me over and said he was stuck. He had not drawn a line and did not know where to begin. After I had lambasted him, he confessed that he had never done anything in the way of machine drafting, but had been engaged entirely on railroad-track work. I kept him on for the balance of the week and then paid him off.

The point I am trying to bring out is that a man should truthfully state in as few words as possible just what he can do, and from my 35 years' experience, I have no hesitancy in stating that his replies, if properly written, will be given due consideration.

This is our delayed issue of Dec. 11, 1919. This news is however up to date, having been prepared for our Dec. 18 issue

Sparks from Industry's Forge

Edited by E. C. Porter

Elaborate Plans for New York and Chicago Automobile Shows

That the New York and Chicago automobile shows will constitute a more complete exposition of the automotive industry than ever before in the successful history of these shows is apparent from a statement issued by S. A. Miles, manager of the National Automobile Shows, that there will be on display 87 different makes of passenger cars, 70 of motor trucks and 284 of accessories. Of the passenger-car exhibitors 84 have entered both the New York and the Chicago shows; two will appear in Chicago only and one in New York only. At the New York Motor Truck Show no less than 63 different makes of trucks will be displayed, while to date 50 makes have secured space for the Chicago truck show. The New York passenger-car and truck shows will be held during the week of Jan. 3-10, while the Chicago show will be held Jan. 24-31. In New York passenger cars will be exhibited on four floors of Grand Central Palace, while the truck exhibit will be held in the 8th Coast Artillery Armory, the largest in the United States. The Chicago passenger-car show will be held in the Coliseum and Armory, while trucks will be displayed in the International Amphitheatre.

* * *

"The Tech Engineering News"

The managing board of the Massachusetts Institute of Technology, Cambridge, Mass., is about to start the publication of an engineering paper to be called "The Tech Engineering News." This step is taken as a result of the interest which has been shown in the articles dealing with engineering subjects which "The Tech" has published from time to time, and which have been favorably commented upon by friends and alumni in this country and England.

"The Tech Engineering News" will be issued without additional charge to regular subscribers of "The Tech," now numbering about 3000, and will have additional circulation among students and alumni of the Massachusetts Institute of Technology, and engineers and business men throughout the country. It will be published monthly.

The purpose of the paper will be to keep its readers informed of current events of interest in the field of industry, the most recent advances in engineering science, and of the results of researches and original investigations. It will aim to develop in the students at the institute a better knowledge of the actual conditions of industry which they will meet upon graduation, and to interest them in the current progress in the different branches of science.

It is planned to publish a number of short articles in each issue, and a few of slightly greater length describing some new achievements in science or industry, written simply so that they may be read without effort and will interest the majority of the readers. The paper will be illustrated.

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French Fair at Lyons

The spring session of the Lyons Fair, to be held at Lyons, France, from Mar. 1 to 15, 1920, is now in course of preparation. The preliminary work of gathering together those manufacturers who will display their products at the exposition has already begun, and especial attention is being paid to American articles.

Ernest Perrin has been designated the official representative of the fair authorities in the United States and has established offices in New York City.

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Automotive Engineers Will Hold Meeting in Chicago Jan. 28

A meeting of the Society of Automotive Engineers which will be devoted to discussions of truck and tractor subjects will be held at the Hotel La Salle, Chicago, on Jan. 28, 1920 (Wednesday of Chicago automobile show week). There will be professional sessions in the morning and afternoon. Among the papers tentatively scheduled for presentation at the Chicago meeting are the following: Design of Pneumatic Tired Trucks, by P. W. Litchfield; Decreasing Unsprung Weight by Use of Aluminum, by A. H. Edgerton; Effect of Tire Equipment on Truck Design, by S. V. Norton; Standardization of Military Tractor Engines, author to be announced; Tractor Testing for Rating Purposes, by Prof. L. W. Chase.

* * *

The Use of Tractors Increasing

The use of tractors is rapidly increasing throughout the country. There were about 132,000 tractors produced last year. This year's production is estimated at around 315,000.

The tractor multiplied the man power of farms. It enabled the farmers to produce millions more bushels of grain than they could have possibly raised without it.

New Machinery Manufacturing Plant for Fort Worth, Texas

A plant for the manufacture of heavy drilling and finishing tools is being erected at Fort Worth, Tex., by the Fort Worth Drilling Tool Co. J. M. Loffland of Woodsfield, Ohio, is president of the company and B. E. Berne formerly of Houston is vice president. Mr. Loffland and his brother T. S. Loffland were formerly associated in the Loffland Brothers Manufacturing Co., of Woodsfield. Their plant was recently sold and both men will be interested in the Fort Worth venture. A site of eight acres lying within the city and adjacent to the M. K. & T. tracks has been purchased. Storage tracks accommodating 20 cars have been laid. Steel and other building material is already on the ground. Work on the plant is to be rushed and the company expects to be in full operation by Jan. 1. One hundred and sixty skilled mechanics will be employed.

Buildings to be erected include a machine shop 90 x 120 ft.; a forge shop 51 x 122 ft., and an office building 34 x 45 ft. It will contain an emergency hospital, drafting rooms, offices and recreation rooms for employees.

* * *

The Western Society of Engineers Announces the Robert W. Hunt Prize

The Western Society of Engineers announces the receipt of an annual prize of $250 from one of its members which shall be known as the "Robert W. Hunt Award." This has been founded with the idea of assisting to make the membership in the society useful and attractive to the younger men of the profession, and will be granted each year for the best paper contributed to the proceedings of the society on any subject pertaining to the manufacture or treatment of iron or steel products. For the purposes of this award Capt. Robert W. Hunt has placed $5000 in trust in a Chicago bank.

The detailed conditions of the award are not yet available but among the requirements will be that the members submitting the papers must not be over 30 years of age nor a member of the faculty of an educational institution. Should the judges consider no paper worthy of that year's award, it is to go to the St. Luke's Hospital, and if the society shall fail to make an award for five consecutive years, the deposited securities are to be turned over to the hospital.

Bureau of Standards Asks for $3,000,000 to Carry on Its Work

Nearly $3,000,000 has been asked by the Bureau of Standards to carry on its work for the next fiscal year. Many of the appropriations asked are for work of direct interest to machinists. Some of the items are as follows: For maintenance and operation of testing machines, and for the determination of the physical constants and the properties of materials, $55,000 (an increase of $20,000 over the appropriation for the current fiscal year). For developing methods of testing and standardizing machines, motors, tools, measuring instruments and other apparatus and devices used in mechanical, hydraulic, and aëronautic engineering, $40,000 (an increase of $25,000). To provide for the standardization and testing of standard gages, screw threads and standards required in manufacturing throughout the United States and to calibrate and test gages, screw threads and standards, $60,000 (an increase of $20,000). For investigation of methods of high-temperature measurements and control in various industrial processes, $10,000. To investigate conditions of personal hazard in electrical and industrial establishments and other places where apparatus and machinery are used, or hazardous materials are handled. To formulate safety standards covering construction, installation, and operation of electrical and mechanical apparatus and machinery, $50,000. To enable the Bureau of Standards to cooperate with manufacturers, engineers and Government departments in the establishment of standards, methods of testing and inspection of instruments, equipment, tools, and electrical and mechanical devices, $75,000. To determine the characteristics of instruments used in the measurement of gas, air and steam, $10,000. For equipment and operation of a laboratory for the standardization of the conditions of lubrication and combustion in motors, $50,000. For the maintenance and equipment of gasoline in engine-testing plants, including vacuum and refrigerting machinery, for testing engine fuels, carbureters, ignition devices, radiators and cooling systems, $150,000.

* * *

International Sample Fair to Be Held at Milan, Italy

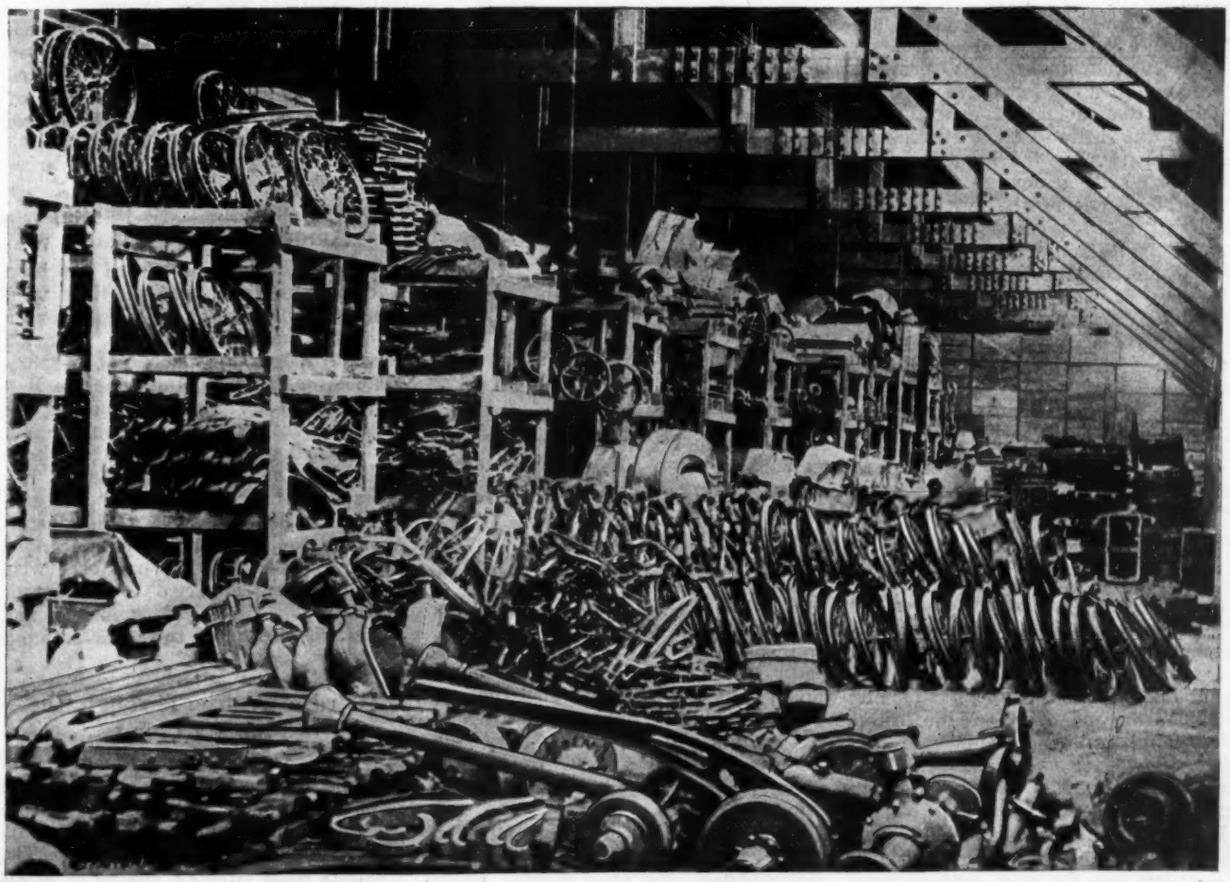
An international sample fair will be held at Milan, Italy, in March, 1920. This is an exceptional opportunity for American exporters to introduce their goods to that market. Exhibitors should communicate with the American Chamber of Commerce at Milan, or with the Foreign Trade Research Bureau of the Italian Discount and Trust Co., 399 Broadway, New York.

Trade Currents From Cleveland and Chicago

CLEVELAND LETTER

Machinery trade of the Cleveland and northern Ohio district becomes more spotted as the year closes. While a satisfactory bulk of new business is coming forward from the automobile industry (still the principal consumer of equipment), there is a perceptible slowing down, in the opinion of leading distributors, in general manufacturing requirements. While the ordinary inventory taking at this time of year is largely responsible for this lack of real buying interests, a more important factor, that of lack of coal in the immediate future, now is being recognized by all industries. The effect of fuel shortage, now imminent as miners in Ohio refused to go back to work, assumed alarming proportions, outshadowing the effects of the steel strike, now practically over. In fact mills that have weathered the steel strike now threaten to close, and in fact at least two steel plants have shut down already for lack of fuel.

In addition to this comes now the hint from the Cleveland Federal fuel committee that it may back up the Garfield fuel conservancy order by prohibiting the use of electrical power in plants that obtain this power from the illuminating company. It is also expected



Huge stocks of automobile parts in the U. S. Army warehouses at St. Nazaire, France, part of the American Army supplies sold to the French Government for $300,000,000.

that the municipal lighting plant will be prevented from applying such power. While these orders are aimed at non-essential production, as that was designated in war times, general manufacturing, including that related to the machinery industry, just now take cognizance of the extreme situation close at hand.

Because of these developments, local and nearby requirements of manufacturers depending upon the machinery industry in this center are not going ahead to any extent with plans for the immediate future, and the bulk of present business appears to be confined to recent negotiations for equipment. Likewise, there is a marked improvement in inquiry from points more distant from the Cleveland machinery district proper, showing that the severe restrictions relating to fuel do not exist so markedly, elsewhere.

As there is hardly sufficient coal on hand or in sight to keep any plants running much beyond the end of December, it is taken for granted by some distributors of equipment in this district that machinery production itself will be curtailed, and the anticipated advances in prices for all equipment will follow, it is believed.

Of interest to machinery producers and distributors throughout the state is the announcement coming from Columbus that steps will be taken by legislators at an early date for the enforcement of a law requiring additional safeguard and shifting apparatus on cone-driven machinery. At present, where speeds must be changed on these machines, the custom of operators is to shift the belts with their hands. Danger of injuring the hand, between pulley and belt, is obvious. It is believed this is one of the first steps in this state to greater safeguard operatives in plants following recommendations at the National Safety Congress. Advocates of the measure point out that similar action in New York and Michigan has been helpful in reducing the number of injuries in machinery operation.

CHICAGO LETTER

The quiet period in machine-tool trade which usually intervenes between Thanksgiving and the New Year, is, so far, conspicuous by its absence in the Chicago market. Not only are manufacturers making deliveries of items ordered during the preceding months but inquiries and actual purchases are keeping up at a really surprising pace. Among transactions of interest during the past week were the sales by one dealer of 16 No. 3 and No. 4 punching machines on one order, and of three 5-ft. radial drilling machines on another. There seems to be no limit to the number of drills and drilling machines the present demand will absorb.

Back orders have accumulated to such an extent that dealers are assured of a good business for some time to come. One dealer states that he now has more business on back orders than ever before in his history, not excepting the strenuous days of 1918, and numerous other concerns state that, while they have made no actual comparison of figures, they believe this to be the case with them. Deliveries on all classes of tools remain about the same as when last mentioned in these letters. One thing worthy of mention is the increasing difficulty experienced in obtaining machine supplies; drills, dies, etc., being in excellent demand with dealers' stocks seriously depleted.

Considerable speculation is being indulged in, in regard to what effect a temporary shutdown of non-essential manufacturing industries, which now seems imminent on account of the fuel shortage, will have on the machinery dealers. Doubtless, it will mean a severe cut in new business, but it is felt that many concerns will take advantage of an enforced closing to go over their plants with a view to replacing badly worn or obsolete tools—an opportunity which has been denied them by the recent rush of business in all lines. All dealers state that they have sufficient coal on hand to care for their office and warehouse heating for an indefinite period.

Business continues to be confined to comparatively small orders from varied sources, the only notable exception being the American Steel Foundries which have recently purchased numerous tools and are still in the market for a few more. The railroads and other great corporations are still out of the market and will doubtless remain so until the various difficulties in the steel, coal and transportation fields are composed.

The enormous advance taken in the building industry in this territory in the past few months certainly holds promise of good business to come. Building permits are being taken out in Chicago at a rate of over four million dollars a week, and at least one-quarter is for industrial enterprises. The equipping of all these new and enlarged plants will require a large quantity of tools.

* * *

New Office Building for Republic Supply Co.

Headquarters of the Republic Supply Co. are to be moved from Houston to Fort Worth, Tex., according to an announcement made by officers of the company. A six-story office building is to be erected at a cost of $100,000 in Fort Worth and the company will employ 100 men in its office. Branches in 22 cities will be served from the main yard at Fort Worth.

The proposed building will occupy the site formerly used by the S. T. Bibb Coal Co. at the corner of North and Lamar Sts.; the property abuts on the T. & P. yards. The office building will be of brick construction and building operations will begin within six weeks.

Supplies for oil-well refineries and gasoline plants will be handled. The traveling salesmen and field representatives will have their headquarters in Forth Worth.

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Gear Factory for Spain

It is reported that a company has been formed in Madrid, Spain, with a capital of $100,000 in order to erect a factory for the manufacture of commercial gears. The president of this company is Juan De LaCierva; the vice president is Giacomino DeAndreis. On the Board of Directors are L. Maestre, Mario H. Finizio, and Henry S. Moos, president of the American Machinery Syndicate, Inc. This plant, it is understood, will be equipped completely with American machines.

Big Demand for Machinery in Japan

A heavy demand for British and American machinery in Japan is reported to the Department of Commerce by Consul General George H. Seidmore of Yokohama. This is said to be concentrated chiefly on machinery pertaining to electricity, electric light and electric trams, steam boilers and the spinning industry.

Several reasons are advanced for the increase. The high cost of coal is given as the cause for the demand for electrical machinery, together with the development of communications and industry. Another factor is that many manufacturers who had intended to import machinery to expand their business during the war, but who hesitated because of the rise in the price of iron, have decided there is little likelihood of a decrease in prices for some time, and that further delay would be fruitless.

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Goods Exported to Belgium Amount to $283,417,698

A particularly good record has been made in renewing trade relations with Belgium. During the first nine months of 1919, the United States exported goods to Belgium to the extent of $283,417,698, or $37 per capita for the Belgian population. Lathes valued at $1,012,113 were exported during the period named. Other machine tools sent to Belgium amounted to $196,834. Exports of sharpening and grinding machines totalled $408,310. Other metal-working machinery exported was valued at $1,707,084. Tools, not otherwise specified, were exported to the extent of $320,566. Electrical machinery and appliances amounted to $648,171.

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Nitrate Traffic Through the Panama Canal

Nitrate formed slightly more than one-fourth of all the cargo which passed through the Panama Canal from the time of its opening to Sept. 1, 1919. It amounted to 7,464,863 tons. The Panama route effects a saving of about 3000 nautical miles in the voyage to European ports from Iquique or Arica, the sources of Chilean nitrate ship-

ments. To New York the saving is about 5000 miles. For a 12-knot ship the voyage to Europe is thus lessened by about 10 days and to New York by about 17 days, with the advantage of cheaper coal by the Canal route.

The nitrate traffic through the Canal has declined very noticeably during the current year. This is ascribed partly to lack of transportation facilities, the cessation of the war and the development of the extraction of nitrogen from the air. During the months the United States was at war (from Apr. 1, 1917, to Nov. 1, 1918) the nitrate shipments through the Canal averaged 191,800 tons a month. From Jan. 1 to Sept. 1, 1919, the average was 24,100 tons.

Personals

GUSTAV BOTTIN has resigned as salesman of the Allied Machinery Co. of France, to accept a similar position with J. Horstmann, Paris, France.

DAVID J. RICE, for the past three years manager of the Detroit office for the Illinois Tool Works, has resigned to become sales manager of the Michigan Tool Co.

EDWIN R. SMITH, for several years works manager of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y., has recently been appointed general manager.

GEORGE ROEMER WOODS has resigned from the Allied Machinery Co. of America to accept a position with the R. S. Stokvis & Zonen Ltd., as manger of its New York office.

A. C. BROWN recently general manager of the Marlin Rockwell Corp., Tacony, Philadelphia division, has resigned and is now associated with the Liberty Motor Car Co., Detroit, Mich.

A. L. BARRETT, formerly assistant manager with the National Machine and Tool Co., of Boston, Mass., has been appointed factory superintendent for the B. & C. Machinery Co., of Hayward, Calif.

MR. MCCRACKEN, for some years in charge of the machine-tool sales for the Fairbanks Co., Philadelphia, has resigned, to enter the woolen business for himself. Mr. Crist has replaced Mr. McCracken with the Fairbanks Co.

H. H. HARRIS formerly general sales manager for the Swedish Crucible Steel Co., has resigned to accept the position as manager for the department of heat-treating equipment of the Quigley Furnace Specialties Co., 26 Cortlandt St., New York.

PAUL M. LINCOLN, for many years commercial engineer of the Westinghouse Co., has resigned from that organization to enter the consulting engineering field, and in that capacity will have active charge of motor application engineering for the Lincoln Electric Co., of Cleveland, Ohio.

CARL EDWARD JOHANSSON, inventor and manufacturer of the Johansson gage, is in America on a business trip. He made an address before the members of the Machinery Club of Chicago at the club quarters at 549 West Washington Blvd., on Saturday evening, Nov. 22. His remarks were on the technical side of the science of gaging.

RICHARD MARTENS, organizer and director-in-chief of R. Martens & Co., Ltd., has resigned his directorship in that firm and severed all connections with British interests and capital. He will devote his entire attention to the promotion of trade between Russia and the United States. His address will remain as at present in care of the firm at 6 Hanover St., New York.

C. F. ROGERS, who, during the entire period of the war, served as Chief Government Inspector on the Vickers and Browning machine guns, both ground and aircraft types, has joined the sales organization of C. E. Johansson, Inc., Poughkeepsie, N. Y., in the capacity of special representative. Mr. Rogers is a mechanical engineer and is a member of the A. S. M. E. He has previously been employed at such representative concerns as the Elgin National Watch Co., Elgin, Ill.; Windsor Machine Co., Windsor, Vt.; and the Bosch Magneto Co., of Springfield, Mass.

Business Items

A. H. Steele & Co., formerly located at Hermon St., Worcester, Mass., has moved into its new factory on Frank Street.

The production Machinery Co., Cincinnati, Ohio, has been chartered with a capital of $53,700 by E. R. Grossman, Robert Ellison, H. A. Grossman, Jr., C. C. McGary and W. H. Burtner, Jr. The concern will manufacture various kinds of machinery.

The Hammond Steel Co., Inc., Syracuse, N. Y., makes the announcement that it is completing extensive additions to its mills at Solvay, N. Y. The extensions include 16 x 10 rolling mills, straightening machinery, turning equipment, new electric furnaces and annealing plants. The company will erect a plant for cold drawing when these extensions are finished.

The Lynn Machine and Screw Co. has commenced operations in the Hoyt Building, Lynn, Mass. This company has purchased the entire equipment of the Hoyt Matson Machine Co. in addition to 30 automatic screw machines. It is planned to add tools, dies, jigs and other equipment in the near future. About 100 skilled mechanics will be employed at present. The president of the new company is M. W. Chipman, for 17 years with the General Electric Co., at Lynn and Pittsfield, Mass. A. M. Hoyt, Lynn, is vice president and Myron L. Crew, treasurer.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

The representative of a firm in Spain is at present in the United States and wishes to secure an agency for the sale of electric machinery, material for central generating stations, small electric material, pumps, turbines, internal combustion motors, and lamps. References. No. 30,552.

A firm in Denmark (wholesale distributers) desires to secure agencies for the sale of machinery, agricultural implements, tools, metal products, etc. References. No. 30,531.

The electrical engineering department of a municipality in South Africa requires different kinds of electrical supplies, such as twin conductor lead-covered cable, triple concentric cable, boiler tubes, centrifugal pump and motor, recording ammeters, single-phase transformers, sundry supplies, etc. Inquiry forms and blueprints were forwarded and may be examined at the bureau or its district offices. (Refer to file No. 123,150.) Tenders should be forwarded by mail at the earliest possible moment. Ref. No. 30,566.

A mechanical engineer in Italy desires to secure an agency for sale of builders' and general hardware, tools, metals, mechanical goods, office and other furniture, and provisions. Correspondence should be in Italian. References. No. 30,560.

A company in China desires to purchase machinery and parts of machinery, drills, air pumps, bellows and forges, crankshafts, emery wheels, crucibles for melting brass, chain blocks, air gages, belting, engines for motor boats, dynamos, magnetos, motors, nonfriction metals, pig iron, and tools. The dynamos and magnetos are needed for immediate use. Quotations should be given c.i.f. Hongkong. Terms, cash against documents. References. No. 30,588.

The American office of a firm in Sweden desires to be placed in communication with manufacturers with a view to securing agencies for the sale in the Scandinavian countries of agricultural machinery, belting, cutlery, technical and industrial machinery, locomotives, textile machines, railway and street-car supplies, materials for construction, motor trucks, engines, iron, coal, etc. References. No. 30,590.

An agency on commission basis is desired by an association in Italy for the sale of industrial machinery, automobiles, agricultural implements. Correspondence may be in English. References. No. 30,610.

The Irrigation Board in a Province of South Africa is in urgent need of construction machinery and equipment. A list of the supplies needed may be had on application to the bureau or its district offices. (Refer to file No. 40,595.) Quotations and full details are requested at once. No. 30,662.

An agency is desired by a man in Italy for the sale of hydraulic turbines, machine tools, electrical machinery and supplies, and mechanical goods in general. Correspondence may be in English. Reference No. 31,203.

An engineer in Belgium desires to purchase and secure an agency for the sale of industrial material and machines, turbines, boiler equipment, lathes, planing, shaping machines, etc.; agricultural machines, industrial chemical products. Quotations should be given c.i.f. Antwerp and Brussels. Terms, payment against documents or with bank credit. Correspondence should be in French. Reference No. 31,271.

The purchase of fine tools, taps and dies, drill presses, lathes, saws, milling machines, etc., is desired by a man in Czechoslovakia. An agency is also desired. Payment in United States currency. Correspondence may be in English. References. No. 30,627.

Agriculturists in South Africa are particularly anxious to secure tractors of the caterpillar variety, and catalogs are requested by an American consulate. Quotations should be given f.o.b. on 45-hp. caterpillar tractors, with cable address and all necessary information. It is also desired that the engine shall be of the kind to start on gasoline and to run on kerosene. Reference No. 31,270.

New Publications

Foundry Practice.—By R. H. Palmer. John Wiley & Sons, New York, 390 pages, 217 illustrations.

In this book the author has dealt with all phases of foundry work in a way that while instructive to practical men, will enable the layman to gain a comprehensive idea of the foundryman's art. As a textbook for use in industrial schools it is one of the best we have seen. It is perhaps unfortunate that in the part of the book devoted to molding machines, the author has seen fit to describe and illustrate the machines of only one maker. A copy of this book should be in the library of every manufacturer using castings.

Among Industrial Workers. Compiled by the Industrial Department of the International Committee, Young Men's Christian Association. Published by the Association Press, 347 Madison Ave., New York City. One hundred and fifty-four 6 x 9-in pages, profusely illustrated.

Deals with the many problems to be confronted in the process of educating industrial workers to the duties of intelligent citizenship; with particular reference to the foreign born, and to the native-born children of foreign parents, who have been brought up in ignorance of American ideals. Gives important statistics concerning the distribution of industrial workers, both native and foreign, throughout the country, and outlines the policy of the Association with reference to them.

Applied Science for Metal Workers. By William H. Dooley. Bound in red-cloth boards. Four hundred seventy-nine 5 x 7¼-in. pages, 205 illustrations. Published by the Ronald Press Co., New York.

This book covers a large number of mechanical subjects in a general definitive way. The chapters are divided into textbook form and the various chapter titles are: Science and the Properties of Matter; Weights and Measures; Mechanical Principles of Machines; Leverage; Pulleys, Inclined Planes, and Wedges; Laws of Motion; Mechanics of Liquids; Properties of Gases; Heat and Expansion; Light, Color and Sound; Principles of Chemistry; Acids, Alkalines and Salts; Physico-Chemical Processes; Chemistry of Common Industrial Substances; Magnetism and Electricity; Frictional or Static Electricity; Generation of Electricity on a Commercial Basis; Transmission of Electrical Energy; The Telephone and Telegraph; Science Underlying Mechanical Drawing Supplies; Strength of Materials; Common Fastening Agents; Common Hand Tools; Transmission of Power; Boilers and the Generation of Steam; The Steam Engine; Methods of Heating; Ventilation; Gas Engines; Iron and Iron Molding; Problems of Pattern Making; The Making and Working of Wrought Iron; Structural Steel; Machine-Shop Practice; Sheet Metals; Plumbing and Water Supply.

Practical Mathematics for Home Study. By Claude Irwin Palmer. Four hundred and ninety-three 4¾ x 7¾-in. pages, 299 illustrations and 11 tables. Bound in dark-green flexible cover. Published by the McGraw-Hill Book Co., 239 West 39th St., New York.

This book treats of the essentials of arithmetic, algebra, geometry and trigonometry. The author previously published a four-volume series covering the four subjects mentioned. This volume includes all of the subject matter used in the series, to which has been added a number of new topics together with many solutions of exercises, and suggestions that make the text more suitable for home study. The work has been written for the adult student, and an endeavor has been made to make him feel that he is in actual touch with real things. The nearly 3000 drill exercises and problems are, in most cases, new. Many of them are adapted from engineering and trade journals, from handbooks of various kinds and from treatises on the steel square and other mechanical devices. Other problems are from the author's experience, and still others were proposed by members of classes studying the course during its development. Care has been taken to make all as true to practice as possible. Part I covers arithmetic. Part II covers everyday geometry. Care has been taken to give a clear idea of the definitions without being too technical. The subjects are treated in mathematical order, though many applications are given under separate headings, such as brick work, lumber, the steel square, screw threads, circular mils, belt pulleys and gears. Part III gives sufficient drill in algebra for common practical uses. Much attention is given to formulas and their transformations. The equation is applied to many practical problems, and graphical methods are considered. Part IV gives considerable work on the use of logarithms. In trigonometry the practical applications are chiefly dealt with. Many examples are given. The tables that accompany the work are to four decimal places.

Trade Catalogs

"Make Your Machine Shop Larger"—Without Adding More Floor Space or Machines." A little pamphlet issued by the Haynes Stellite Co., Kokomo, Ind. The book is descriptive of stellite, its origin, its accomplishments, and its future, and affords an interesting story of this cutting material. Incidentally, it contains a lot of useful information in regard to welding of stellite tips on carbon-steel chains and directions for the grinding of these tools in order to obtain the maximum service from them.

Reamers, Cutters and Special Tools. The Detroit Reamer and Tool Co., Detroit, Mich. Catalog No. A, pp. 141, 7¼ x 4¾ in. This catalog gives complete information on all the tools it manufactures and also gives illustrations of the Morse taper shanks and Brown & Sharpe taper shanks. Several pages are given of decimal equivalents and U. S. Standard gage for sheet metal.

Tool Steel. Edgar T. Wards Sons Co., Boston, Mass. Catalog No. O-4, pp. 135, 8½ x 5½ in. A descriptive catalog of its line of steels, sizes and specifications included.

Portable Electric Machinery. Hergi Manufacturing Co., 75 Third St., Bridgeport, Conn. Bulletin Nos. 10-13, 11 x 8½ in. An illustrated and descriptive bulletin of its various products such as die sinking, scraping and screwdriving outfits.

Electric Drills. Independent Pneumatic Tool Co., Chicago, Ill. Circular, 6 x 3½ in., illustrating and describing its electric drills; specifications also included.

The High Cost of New Equipment. Du Pont Chemical Co., Wilmington, Del. Catalog, pp. 12, 6½ x 3½ in. A complete list of its general manufacturing and machine-shop equipment.

Brass-Rolling Mill. The Electric Furnace Co., Alliance, Ohio. Booklet, No. 17-B, pp. 8, 11 x 8 in. This booklet describes a special furnace for rolling mills which is designed for pouring the metal directly into the molds.

Electric Furnace. The Electric Furnace Co., Alliance, Ohio. Booklet, No. 7-B, pp. 15, 11 x 8 in. It describes and illustrates its standard 105-kw. brass-melting furnace.

Electric Furnace for Melting Non-Ferrous Metals. Issued by the Electric Furnace Co., Alliance, Ohio. Booklet No. 13-B, pp. 12, 11 x 8 in. This booklet is a careful discussion of the various electric non-ferrous metal melting furnaces, which was delivered at the Boston meeting of the American Institute of Chemical Engineers.

Weldless Wire Chains. The Chain Products Co., Cleveland, Ohio. Catalog. pp. 112, 8½ x 11 in. This catalog is printed in two colors and is bound with heavy cardboard. It contains some very interesting information about chains and its uses. Various kinds of chains are illustrated by halftone engravings, and the many purposes for which they may be used are suggested by a succession of artistic drawings. A copy of this catalog may be obtained by anyone interested in the subject of chains.

Medart Friction Clutches. Medart Patent Pulley Co., Inc., St. Louis, Mo. Catalog, pp. 16, 4 x 9 in. Brief descriptions of the V-groove, straight-ring and compression type clutches made by the company are given together with a sketch discussing the need for friction clutches and cut-off couplings. Applications of the several clutch types to various pulleys are also described.

Electrical Screwdriver and Drills. George C. McKay Co., Cleveland, Ohio. Catalog, 6 x 9 in, pp. 8, illustrated. A complete description of the tools is given, as well as the directions to use them.

What the "Any Angle" Wrench Does. Automatic Transmission Co., Lima, Ohio. Folder, 3½ x 8½ in., illustrated. The variety of uses to which this wrench can be put is described, as well as the details of the wrench itself.

Service to Exporters. C. K. Thomas & Co., New York City, N. Y. Booklet, 3½ x 5½ in., 12 pages. The engineering work which this company has executed for exporters is described.

De Laval Marine Bulletin No. 103. De Laval Separator Co., New York and Chicago. Booklet, 8 x 11 in., pp. 12, illustrated. This booklet gives a complete description of the De Laval method of purifying and reclaiming lubricating oils in steam-driven marine power plants.

The De Laval Method of Reclaiming Crank-Case Oils. De Laval Separator Co., New York and Chicago. Booklet No. 102, 8 x 11 in., pp. 20, illustrated. A description of the De Laval method is given with halftones, drawings and cross-sections of the machines.

Steel and Alloys for Special Purposes. Crucible Steel Co. of America, Pittsburgh, Penn. Booklet, 5½ x 8 in., pp. 107, illustrated. Many descriptions of different steels are given, as well as halftones, charts, tables, scales and formulas.

Truscon Structural Pressed Steel. Truscon Steel Co., Youngstown, Ohio. Booklet, 8½ x 11 in; pp. 23, illustrated. This booklet gives a description of the company's steel for use where light-weight, strong, permanent and fire-resisting floors, walls and partitions are required.

Service Counterbores. Gairing-Needham Tool Co., Detroit, Mich. Booklet, 4½ x 7 in., pp. 12, illustrated. The company's line of counterbores is described and the price list is given.

The De Laval Method of Purifying and Reclaiming Oils. De Laval Separator Co., New York and Chicago. Booklet No. 100, 8 x 11 in., pp. 24, illustrated. The company's methods of reclaiming lubricating, cutting, hardening and fuel oils are given; also some cross-sections of the machines, showing their construction.

Type Transformer. Wagner Electric Manufacturing Co., St. Louis, Mo. Bulletin No. 119; describes and illustrates the type, insulation tests, and mechanical features of the type transformer.

Forthcoming Meetings

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia, Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The motor-truck sections of the 20th Annual Automobile Shows of 1920 will hold an exhibition in the 8th Coast Artillery Armory, New York, Jan. 3 to 10, 1920, and in the International Amphitheatre, Chicago, Ill., Jan. 24 to 31, 1920.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday, O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Society of Automotive Engineers will hold its annual meeting in New York on Jan. 6 to 8, inclusive. For further information of program, address the meeting committee, 239 West 39th St.

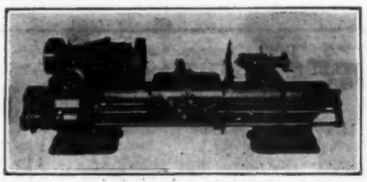
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Lathe, 24-In. Geared-Head

Greaves Machine Tool Co., Cincinnati, Ohio.

"American Machinist," Sept. 4, 1919.

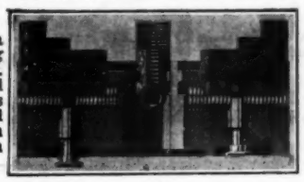


Swing over ways, 27½ in.; swing over carriage, 18 in.; takes between centers, 4 ft. 10 in.; hole through spindle, 2¼ in.; number of spindle speeds, 12; range of spindle speeds, 8, 280; speed of driving pulley, 336 r.p.m.; taper of centers, No. 5 Morse; tailstock-spindle travel, 13½ in.; length of carriage bearing on bed, 39½ in.; carriage bridge width, 11½ in.; lead screw, 2 in. in diameter, two threads per inch, right-hand Acme; feed rod, 1¼ in. in diameter; cut threads, ½, 28; feeds, 5, 280; apron ratio, 10-1; compound rest travel, 8 in.; size of lathe tool, 1 x 1¼ in.; bearing of tailstock on bed, 20 in.; spindle nose, 6¼ in. diameter, 1¼ in. length; spindle nose pilot, 4 in. in diameter, 2¼ in. length; motor horsepower, 7½, 10; motor speed, about 1200 r.p.m.

Chuck, Quick-Change

Dayton Reliance Tool and Manufacturing Co., Dayton, Ohio.

"American Machinist," Sept. 4, 1919.



Jaw and screw removable as a unit by withdrawing retaining plunger located by ball check. Inspection, cleaning and reversal made simple and rapid by this device. Screws have squared openings in both ends. Made in seven sizes from 8 to 18 in. in diameter.

Planing Tool, "Both-Ways"

Otto H. Cronau, 330 East 87th St., New York City.

"American Machinist," Sept. 4, 1919.

Body carries two small swinging holders each with square broached hole for standard bit. Holders are pivoted and act in the same manner as shaping-machine clapper on opposite strokes. Upper ends of clapper linked to prevent drag of idle tool. May be set so that one tool takes roughing cut and other finishing cut. Made in two sizes with shanks 1 x ¼ in. and 1¼ x ⅜ in.

Vise, Drilling Machine Table "Quick-Grip"

Sprague-Hayes Manufacturing Co., 40 East Larned St., Detroit, Mich.

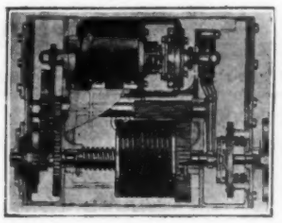
"American Machinist," Sept. 4, 1919.

Vise shank is made large enough to allow for turning down to fit any standard drilling machine. Vise jaws have interchangeable machine steel faces. Vise screw is 1½ in. in diameter four threads to the inch. Diameter of table, closed, 16 in.; jaws open, 8 in.; size of table when open, 16 in. x 24 in.; steel jaw faces, 16 x 1½ in.; weight, 115 lb.

Hoist, Heavy-Duty

Victor R. Browning & Co., Cleveland, Ohio.

"American Machinist," Sept. 4, 1919.



Adapted for use where head room is limited or available space otherwise restricted. Gears and load brake revolve in oil. Controller and motor shaft in separate compartment, readily accessible for inspection and repair. Limit attachments installed to prevent overtravel of drum in either direction. Furnished with either direct- or alternating-current motor and can be suspended from overhead trolley or I-beam.

Heatmeter

Brown Instrument Co., Philadelphia, Penn.

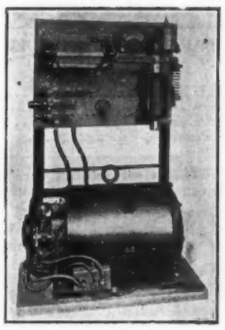
"American Machinist," Sept. 4, 1919.

Rheostat cuts in a resistance equal to and balancing the resistance of the thermocouple and the leads. With the instrument connected the operator has only to note the reading, press the key on the left-hand side of the instrument and again note the reading. If the two readings do not agree he turns the adjusting knob on the top of the rheostat until the internal resistance balances the external and the two readings become the same. Claimed to make readings independent of distance from thermocouple to instrument.

Welding Unit, "Plastic-Arc"

Wilson Welder and Metals Co., 2 Rector St., New York City.

"American Machinist," Sept. 4, 1919.

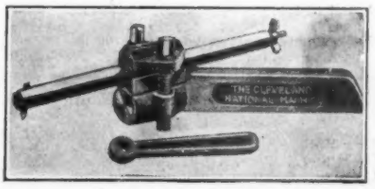


Set consists of flat compound-wound generator and current-control panel. Slate panel, 20 x 27 in., carries three switches providing current adjustment between 25 and 175 amperes. Can be furnished with dynamotor unit for 110 or 220 volt d.c. or 220 or 440 volt, 60 cycle, 2- or 3-phase, a.c.; also as gasoline-driven unit or belt-driven. Normal generator speed, 1800 r.p.m.; weight, 800 lb. with d.c. motor, 807 lb. with a.c. motor, 1200 lb. with gasoline engine, 550 lb. as belt-driven outfit. Can be mounted on a truck for easy portability.

Toolholder, Boring

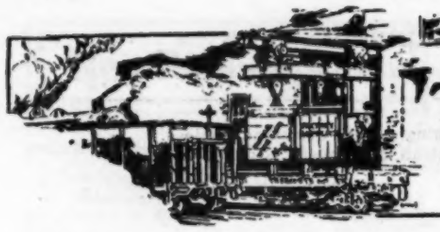
Cleveland National Machine Co., 1354 West 70th St., Cleveland, Ohio.

"American Machinist," Sept. 4, 1919.



Can be rotated around the end of the shank so as to bring the bar at the height of the lathe center without blocking. The same screws that clamp the bar also lock the bar holder in position on the shank. The holder will take not only the special bar shown in place, but any round forged boring bar within its capacity. It will also hold indicators, drills or reamers. The regular shank is ¾ x 1¼ in., and the holder will take rounds from ½ up to ⅞ in. in diameter.

Patented Aug. 20, 1918



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$36.60	$32.60
Northern Basic	34.00	31.05
Southern Ohio No. 2	36.55	31.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	39.40	35.65
Southern No. 2 (Silicon 2.25 to 2.75)	41.40	36.50
BIRMINGHAM		
No. 2 Foundry	33.00	30.00
PHILADELPHIA		
Eastern Pennsylvania No. 2	38.10*	33.00*
Virginia No. 2	39.10*	34.40*
Basic	34.60†	29.00†
Grey Forge	34.60*	29.40*
CHICAGO		
No. 2 Foundry local	36.25	31.40
No. 2 Foundry, Southern	38.00	34.10
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	.....	32.40
Basic	34.40	28.40
Bessemer	35.40	29.35

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$3.47	$4.27	$3.37	$4.17	$3.47	$4.27
Soft steel bars	3.52	3.52	4.17	3.27	4.17	3.52	4.17
Soft steel bar shapes	3.52	3.52	4.17	3.27	4.17	3.52	4.17
Soft steel bands	4.22	4.22	4.77	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	3.67	3.67	4.52	3.57	4.42	3.67	4.25

Note—For less than carload lots, add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, N. Y.	$3.10	$3.50
Warehouse, New York	3.52	4.75
Warehouse, Cleveland	3.42	4.67
Warehouse, Chicago	3.52	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

	Mill, Carloads, Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 28 black	$4.35	$6.00	$6.52	$5.77	$6.00
No. 26 black	4.25	5.90	6.42	5.67	5.90
Nos. 22-24 black	4.20	5.85	6.37	5.62	5.85
Nos. 18-20 black	4.15	5.80	6.32	5.57	5.80
No. 16 blue annealed	3.75	5.02	5.72	5.17	5.02
No. 14 blue annealed	3.65	4.92	5.62	5.07	4.92
No. 10 blue annealed	3.55	4.82	5.52	4.97	4.82
No. 28 galvanized	5.70	7.25	7.77	7.12	7.25
No. 26 galvanized	5.40	6.95	7.47	6.82	6.95
No. 24 galvanized	5.25	6.80	7.32	6.57	6.52

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.00	$4.90	$4.75
Flats, square and hexagons, per 100 lb. base	5.50	5.40	.....

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$15.50–1900
Cleveland	20.00	20.00
Chicago	16.50	19.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
⅛, 5/32, ⅙, ¼, 5/16, ⅜, No. 8, 7/16 and No. 10, ½, No. 12, 9/16, No. 14 and ⅝, No. 18, No. 20	21.00 to 30.00	7/16 by 12 in. long	14.00
		½ by 19 in. long	12.00
		⅝ by 19 in. long	10.00
		¾ by 21 in. long	10.00
		Special Welding Wire, Coated	
		⅛	33.00
		5/32	30.00
		⅙	38.00

Domestic 20c. for 5/32, 15c. for ⅛ to ⅙

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.00	8.00	8.00
Spring steel (light)	8.00	10.00	10.00
Coppered bessemer rods	8.00	8.00	6.75
Hoop steel	4.47	4.75	4.07
Cold-rolled strip steel	8.40	8.25	7.50
Floor plates	5.67	6.00	5.92

Note—For less than carload lots, add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	50½%	24%	⅛ to 1¼	30%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	⅛ to ⅜	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	49%	2½ to 4	.....	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	Black	Galv.	Black	Galv.	Black	Chicago Galv.
⅛ to 3 in. steel butt welded	47%	31%	43½%	34½%	57½%	44%
2½ to 6 in. steel lap welded	42%	27%	45½%	39½%	53½%	41%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 12½% less 5%. Cast iron, standard sizes, 10–5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	18.50–18.75	20.00	26.00
Tin in 5-ton lots	54.25	53.87½	72.00
Lead	6.90	6.80	7.05
Spelter	8.95	8.30	8.60
ST. LOUIS			
Lead	6.35	6.55	6.75
Spelter	8.10	7.95	8.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

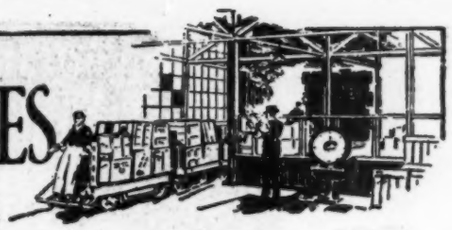
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	28.50	33.50	38.00	29.50–31.00	34.00	35.00	38.00
Copper wire (carload lots)	28.00	29.00	35.00	28.50	36.00	26.00	38.00
Brass sheets	25.50	32.00	39.75	28.00	32.00	26.00	38.00
Brass pipe	30.50	36.00	46.00	34.00	42.00	34.00	44.00
Solder (half and half) (case lots)	35.00	45.00	55.00	35.00	50.50	33.00	65.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	22.75	37.75
New York	24.00	34.25
Cleveland	28.00	38.50
Chicago	25.00	29.50

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 11.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	11.50	18.75	12.00	18.40
New York	12.00	17.00	12.50	17.50
Chicago	15.00	22.00	15.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	9.75-10	9.50-10.50
Chicago	9.50	10.00
Cleveland	11.75	11.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy and crucible	17.50	20.00	17.50	19.00	16.50
Copper, heavy and wire	15.50	19.00	17.50	19.00	16.25
Copper, light and bottoms	13.50	17.00	15.00	15.00	15.25
Lead, heavy	6.25	6.00	5.50	6.00	6.00
Lead, tea	5.00	4.75	4.00	4.00	5.00
Brass, heavy	9.00	11.00	13.00	14.00	16.00
Brass, light	8.00	9.00	9.50	13.00	9.50
No. 1 yellow brass turnings	9.50	11.00	10.50	10.00	10.00
Zinc	5.00	5 25	5.50	5.00	6.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00c.	32.00c.@3.00c.	33½c.

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	34.00	32.00
Chicago	28.00	38.00
Cleveland	31.00	36.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	70.00	80.00	60.00	95.00
Commercial	55.00	45.00	16.50	21.50	13.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	List	.80	$2.25	$1.25	$1.45	.98
Hot pressed hexagon	List	.80	2.25	1.05	1.45	.78
Cold punched hexagon	List	2.50	2.25	.75	1.05	1.00
Cold punched square	List	2.50	2.25	.75	1.05	1.00

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	70-5%	50-10%
Chicago	50%	50%
Cleveland	60-10%	50-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	40%	50%	35-5%
Larger and longer up to 1½ in. by 30 in.	30%	40%	25-5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... $1.25 Cleveland..... $3.75 Chicago..... $3.00

For cast-iron washers the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $3.75 Chicago..... $4.25

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	35%	40-5%	30%
Larger and longer up to 1 in. by 30 in.	25%	37½%	20%

COPPER RIVETS AND BURS sell at the following rate from warehouse.:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	30%	List plus 10%	30%	List plus 10%
Chicago	20%	List price	20%	List plus 20%
New York	30%	15% from list	10%	List plus 5%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	50%	55% off	50%
Tinned	50%	55% off	50%

Boiler, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York...$5.00 Cleveland...$4.00 Chicago....$4.87 Pittsburgh...$4.72

Structural, same sizes:
New York...$5.10 Cleveland...$4.10 Chicago....$4.97 Pittsburgh....$4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	32.00	36.00	35.00
Brass	30.50	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

COTTON WASTE—The following prices are in cents per pound:

NEW YORK				
Current	One Year Ago	Cleveland	Chicago	
White	13.00	1.00-13.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50-12.00	11.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.25	$1.75	$1.75
Philadelphia	2.00	1.75	1.75
Cleveland	2.50	2.50	2.40
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.40	$3.65	$3.65
Cleveland	3.875	3.875	4.25
Chicago	4.12½	4.125	4.50

COKE—The following are prices per net ton at ovens, Connellsville:

	Dec. 2	Sept. 18
Prompt furnace	$7.00	$4.60
Prompt foundry	6.50	6.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.80	$1.59	$2.09	$1.90
5-gal. cans	1.93	1.84	2.34	2.00

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	14.00	16.10	14.00	14.50	14.00	14.00
25 and 50-lb. kegs	14.25	15.75	14.25	14.75	14.25	14.25
12½-lb. keg	14.50	16.00	14.50	15.00	14.50	14.50
5-lb. cans	16.00	17.50	.....	.....	16.00	16.00
1-lb. cans	17.00	18.50	.....	.....	17.00	17.00

500 lb. lots less 10% discount. 2000 lb. lots less 10-2½% discout.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Bridgeport Hardware Manufacturing Co., 461 Iranistan Ave., has awarded the contract for the construction of a 2 story, 40 x 125 ft. factory, on Washburn St. Estimated cost, $35,000.

Conn., Bridgeport—The Coulter & McKenzie Machine Co., 771 Water St., will soon award the contract for the construction of a 1-story machine shop on Seaview Ave. W. R. Phillips & Co., 24 John St., Engr.

Conn., Bridgeport—G. T. McCarthy, 929 Irvaniston Ave., will build a 1 story, 82 x 145 ft. garage on Fairfield Ave. and Auburn St. Estimated cost, $29,000.

Conn., Elmwood (Hartford P. O.)—The New Departure Manufacturing Co., 269 North Main St., Bristol, manufacturer of ball bearings, has awarded the contract for the construction of a 2 story, 60 x 220 ft. factory with 60 x 62 ft. ell. Estimated cost, $300,000.

Conn., Hartford—The Hartford Special Machinery Co., Woodland Ave., has awarded the contract for the construction of a 1 story, 60 x 200 ft. addition to its factory, on Homestead Ave. Estimated cost, between $35,000 and $40,000.

Conn., Meridan—Manning, Bowman & Co., Pratt St., has awarded the contract for the construction of a 5 story, 50 x 130 ft. factory for the manufacture of silver peaters. Estimated cost, $65,000.

Conn., New Britain—The New Britain Machine Co., 140 Chestnut St., manufacturer of automatic woodworking machinery, has awarded the contract for the construction of a 1 story, 32 x 320 ft. factory, with 40 x 70 ft. ell. Estimated cost, $40,000.

Conn., New Britain—The New Departure Manufacturing Co., 269 North Main St., manufacturer of ball bearings, has awarded the contract for the construction of a 1 story, 100 x 220 ft. and a 4 story, 110 x 220 ft. factory, 1 story, 50 x 92 ft. boiler house, a 2 story, 40 x 130 ft. transformer house, a 2 story, 30 x 30 ft. printing plant, a 1 story, 50 x 65 ft. addition to carriage shop, at the main plant, and a 1 story, 40 x 126 ft. forge shop, a 1 story, 45 x 60 ft. boiler house, a 1 story, 70 x 240 ft. storage house, a 1 story, 70 x 265 ft. machine shop and a 2 story, 40 x 80 ft. office, at the north plant.

Conn., New Haven—The Oven Equipment and Manufacturing Co., 205 Orange St., plans to build a 1 story, 90 x 280 ft. factory on Lombard St. Estimated cost, $50,000.

Conn., Thomaston—The Seth Thomas Clock Co., Elm St., is having plans prepared by Lockwood, Greene & Co., Arch., 60 Federal St. for the erection of a 5 story factory.

Conn., Waterbury—The Bradford Automobile Sales Co., 476 Meadow St., will soon award the contract for the construction of a 1 and 2 story, 72 x 110 ft. garage and sales station on Meadow St. Estimated cost, $25,000. E. E. Benedict, 51 Leavenworth St., Arch.

Mass., Boston—Snider & Rudnick, 18 Tremont St., will build a 1 story, 70 x 100 ft. automobile sales and service station, on Commonwealth Ave., Estimated cost, $45,000.

Mass., East Springfield (Springfield P.O.)—New England Westinghouse Co., Chicopee Falls, has awarded the contract for the construction of a 1 story, 112 x 250 ft. factory for the manufacture of small electric motors. Estimated cost, $85,000.

Mass., Roxbury—W. H. Lewis, 20 Providence St., Worcester, is having plans prepared by J. A. Tuck, Arch., 108 Intervale St., for the construction of a 2 story, garage on Washington and Circuit St. Estimated cost, $25,000.

Mass., Somerville—H. E. Steeves, Willow St., has awarded the contract for the construction of a 1 story, 110 x 120 ft. garage. Estimated cost, $40,000.

Mass., Springfield—The National Equipment Co., 662 North Main St., manufacturer of confectionery machinery, has awarded the contract for the construction of a 1 story, 150 x 150 ft. factory. Estimated cost, $75,000.

Mass., Worcester—The Franklin Motor Car Co., 3 King St., is having plans prepared by J. Rice, Arch., 306 Main St., for the construction of a 1 story, service station. Estimated cost, $35,000.

R. I., Pawtucket—The Oswegatchie Textile Co., 1075 Main St., has awarded the contract for the construction of a 2 story, 100 x 200 ft. addition to its mill. Estimated cost, $125,000.

R. I., Providence—J. Alix, 1295 North Main St., will build a 1 story, 100 x 100 ft. garage. Estimated cost, $30,000.

R. I., Providence—The L. Vaughn Co., 1153 Westminister St., will build a 1 and 3 story, 20 x 40 ft. and 34 x 98 ft. garage and wood working shop. Estimated cost, $40,000.

R. I., Valley Falls (Pawtucket P. O.)—The Penikees Mills, manufacturers of textiles, has awarded the contract for the construction of a 2 story, 40 x 100 ft. brick weave shed and a 3 story, 85 x 100 ft. addition to main building.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Howell Motor Car Co., Mt. Royal Ave. and Catherine St., has awarded the contract for the construction of a 2 story, 100 x 123 ft. garage and service station, at 913-27 Bolton St. Estimated cost, $55,000.

N. Y., Buffalo—M. H. Meyers, 746 Washington St., had plans prepared by Bellony, Mellishamp & Wade, Arch., Buffalo, for the erection of a 2 story, 60 x 100 ft. garage and showroom on Main St. Estimated cost, $50,000.

N. Y., Middleport—The Niagara Sprayer Co. will build 1 story, 60 x 250 ft. factory. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn)—Rell Realty Co., 39 West 113th St., will build a 1 story, 140 x 140 ft. garage on Albermarble Rd. and Bedford Ave. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—M. Rothschild, 833 Saratoga Ave., will build a 1 story, 75 x 100 ft. garage on Schenectady Ave. and Herkimer St. Estimated cost, $25,000.

N. Y., Rochester—G. J. Bauer, 1462 Culver Rd., plans to build a 2 story, 109 x 115 ft. garage on St. Paul and Franklin St. Estimated cost, $20,000.

Penn., Bloomsburg—C. Housnick, c/o W. H. Lee, Arch., 30 South 17th St., will build a 2 story, 112 x 117 ft. garage and dance hall. Estimated cost, between $40,000 and $50,000.

Penn., Philadelphia—J. F. Arlong, 9th and Green St., has awarded the contract for the construction of a 1 story, 60 x 157 ft. garage, at 3545 North 8th St. Estimated cost, $25,000.

Penn., Philadelphia—The Bigelow Willey Motor Co., 304 North Broad St., is having plans prepared by McIlvaine & Roberts, Arch., 16th and Sanson St., for the erection of a garage and service station on Broad and Vine St. Estimated cost, $100,000.

Penn., Philadelphia—The E. G. Budd Manufacturing Co., 25th and Hunting St., manufacturers of automobile bodies, has awarded the contract for the construction of a 4 story, 100 x 300 ft. factory. Estimated cost, $500,000.

Penn., Philadelphia—M. E. Hecht, Empire Bldg., has awarded the contract for the construction of a 4 story, 56 x 86 ft. garage and storage house, at 1342 Brown St. Estimated cost, $68,000.

Penn., Philadelphia—J. Reale, 1609 Wharton St., will soon award the contract for the construction of a 2 story, 24 x 90 ft. garage and dance hall, on Broad and Wharton St. Estimated cost, $45,000. F. V. Michels, 4400 Manayunk St., Arch.

SOUTHERN STATES

S. C., Greenville—The Southern Textile Machinery Co. plans to build a 3 story, 57 x 117 ft. factory. J. E. Sirrine, Greenville, Arch.

MIDDLE WEST

Ill., Chicago—The American Foundry and Equipment Co., c/o Mundie & Jensen, arch., 39 South La Salle St., has awarded the contract for the construction of a 2 story, 100 x 200 ft. factory, on 47th and Richmond St. Estimated cost, $150,000.

Ill., Chicago—The Cuneo Henneberry Co., 455 West 22nd St., printers, has awarded the contract for the construction of a 2 story, 90 x 125 ft. top addition to its plant on 22nd St. and Cottage Grove. Estimated cost, $85,000.

Ind., Indianapolis—The Dean Steam Pump Works, 323 West 10th St., is having plans prepared by C. Brossman, Arch., 1503 Merchants Bank Bldg., for the construction of a 2 story machine shop. Estimated cost, $25,000.

Mich., Bay City—The Fletcher Auto Sales Co., Saginaw St., has awarded the contract for a 1 and 2 story, 75 x 100 ft. sales and service station, to be erected on Saginaw and 4th St. Estimated cost, $30,000.

Mich., Detroit—R. H. Fyfe, 694 Woodward Ave., will soon award the contract for the construction of a 2 story, 40 x 150 ft. garage and sales station. Estimated cost, $60,000. Smith, Hinchman & Grylls, 710 Washington Arcade, Arch.

Mich., Detroit—J. Green, Michigan Ave. and 8th St., has awarded the contract for the construction of a 1 story, 50 x 195 ft. garage, on Michigan Ave. Estimated cost, $40,000.

Mich., Detroit—C. E. Rodgers, 34 Goldsmith St., has awarded the contract for the construction of a 1 story, 100 x 214 ft. factory on West Fort St., for the manufacture of condensed milk machinery equipment. Estimated cost, $80,000.

Mich., Detroit—M. A. Young, 924 Woodward Ave., is having plans prepared by Mildner & Elsen, Arch., 924 Hammond

Bldg., for a 3 story, 60 x 186 ft. sales and service station, to be erected on Woodward Ave. and Brady St. Estimated cost, $125,000.

Ohio, Cleveland—The Auer Register Co., 403 Long Ave., plans to build a 2 story, 73 x 102 ft. factory on East 37th St. and Payne Ave. Estimated cost, $75,000. A. M. Rose, Secy.

Ohio, Cleveland—The Daugler Stove Co., 5017 Perkins Ave., has awarded the contract for the construction of a 1 story, 50 x 200 ft. addition to its factory. Estimated cost, $50,000.

Ohio, Cleveland—The Dill Manufacturing Co., 694 East 82nd St., metal stampers, will soon award the contract for the construction of a 2 story, 45 x 73 ft. factory, at 688 East 82nd St. Estimated cost, $50,000. E. T. Tobold, Mgr. Withington, Roberts, Wright Co., Swetland Bldg., Arch.

Ohio, Cleveland—The Hydraulic Press Steel Co., Hydraulic Ave., has awarded the contract for the construction of a 1 story, 75 x 200 ft. addition to its factory. Estimated cost, $100,000. G. C. Brainard, Mgr.

Ohio, Cleveland—The Koblitz Plumbing and Heating Co., 1310 Huron Rd., plans to build a 4 story, 144 x 240 ft. office, shop and warehouse, at 5012 Euclid Ave. Estimated cost, $200,000.

Ohio, Cleveland—The Overland Larick Co., 18526 St. Clair Ave. has awarded the contract for the construction of a 2 story, 65 x 150 ft. garage, at 152nd St. and St. Clair Ave. Estimated cost, $50,000.

Ohio, Cleveland—The Rubay Co., 1378 West 78th St., has awarded the contract for the construction of a 3 story, 100 x 120 ft. factory for the manufacture of automobile bodies. Estimated cost, $200,000. L. Rubay, Pres. and Gen. Mgr.

Ohio, Cleveland—The Van Dorn Iron Works Co., 2685 East 79th St., will soon award the contract for the construction of a 3 story, 100 x 120 ft. and a 3 story 100 x 229 ft. factory, on East 79th St. and Woodland Ave. Estimated cost, $250,000. E. McGeorge, 1900 Euclid Bldg., Arch.

Ohio, Dayton — The Stinson Aero Co., East 3rd St., plans to build an airplane plant on East 5th St. Estimated cost, $30,000.

Ohio, Lorain—The Aetna Steel Castings Co., 2884 Scranton St., has awarded the contract for the construction of a repair factory. Estimated cost, $25,000. A. W. Feuton, Pres.

Wis., Milwaukee—The Cadillac Motor Car Co., 1343 Cass St., Detroit, Mich., has had plans prepared by Kirchhoff & Rose, Arch., Majestic Bldg., Milwaukee, for the erection of a 2 story, 121 x 150 ft. service station on North Ave. Estimated cost, $200,000.

Wis., Milwaukee—The City Water Department will soon award the contract for the construction of a 1 story, 50 x 160 ft. meter repair shop, on Market St. Estimated Cost, $50,000. Noted Dec. 25.

Wis., West Bend—The West Bend Aluminum Co., has awarded the contract for the construction of a 4 story, 72 x 144 x 192 ft. and a 1 story, 72 x 120 ft. factory. Estimated cost, $100,000.

WEST OF THE MISSISSIPPI

Iowa, Waterloo—The Waterloo Construction Machinery Co., Park Rd., has awarded the contract for the construction of a 1 story, 60 x 141 ft. factory and foundry. Estimated cost, $60,000.

Mo., St. Charles—C. P. Maloney, 7th and Olive St., has awarded the contract for the construction of a 2 story, 40 x 96 ft. machine shop. Estimated cost, $45,000.

Mo., St. Louis—The American Bakers Machinery Co., Clinton and 9th St., has aquired a site on Kings Highway and plans to build a 2 story, 100 x 300 ft. factory. Estimated cost, $75,000.

WESTERN STATES

Ore., Marshfield—I. Tower plans to build a 2 story, 100 x 100 ft. garage, in Chinatown. Estimated cost, $50,000.

CANADA

Ont., Stratford—The Canadian General Electric Co., Toronto, has purchased the 3 story, 80 x 100 ft. factory of the Mooney Biscuits Works, here, and plans to remodel same for its own use. Estimated cost, $20,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Centerville (New Haven P. O.)—The American Mills Co. has awarded the contract for the construction of a 1 story, 38 x 137 ft. factory, for the manufacture of woolen goods. Estimated cost, $25,000.

Conn., Danielson—The River Weaving Co., Inc., Water St., plans to build an addition to its plant. Estimated cost, $50,000.

Conn., Goodyear—The Goodyear Cotton Mills plan to build a 3 story, 150 x 350 ft. tire fabric yarn mill. Estimated cost, $500,000.

Conn., New Haven—A. C. Gilbert, Blatchey Ave., is having plans prepared by Lockwood, Greene Co., Arch., 101 Park Ave., New York City, for the construction of a 3 story, 80 x 100 ft. factory, for the manufacture of toys. Estimated cost, $80,000.

Conn., New London—The Tidewater Oil Sales Co., 11 Broadway, New York City, has awarded the contract for the erection of an oil distributing station. Estimated cost, $75,00.

Maine, Lisbon Falls—The Walumbo Manufacturing Co. has awarded the contract for the erection of a 2 story, 130 x 197 ft. dye house. Estimated cost, $150,000.

Maine, Sanford—The Sanford Mills, c/o Lockwood, Greene & Co., Arch., 101 Park Ave., New York City, have awarded the contract for the erection of two 1 story dye houses, to be erected here. Estimated cost, $200,000. Noted July 3.

Mass., Boston—The H. L. Hildreth Co., 67 Batterymarch St., manufacturer of candy, is having plans prepared by J. R. Worcester & Co., Engrs., 79 Milk St., for the construction of a 1 and 2 story, 60 x 180 ft. addition to its factory.

Mass., Cambridge—The Cambridge Rubber Co., 748 Main St., has awarded the contract for the construction of a 4 story, 74 x 90 ft. factory. Estimated cost, $50,000.

Mass., East Boston (Boston P. O.)—The Boston & Lockport Block Co., 100 Coudor St., will soon award the contract for the construction of a 2 story, 80 x 245 ft. factory. H. F. Bryant, 334 Washington St., Brookline, Engr.

Mass., Easthampton—The West Boylston Manufacturing Co., Hampton Mills, has awarded the contract for the erection of a 2 story addition to its plant, for the manufacture of tire fabric. Estimated cost, $350,000.

Mass., Fall River—The Mexican Petrolium Co., 164 Allen Ave., Providence, R. I., has awarded the contract for the erection of an oil distributing plant, including office, pump house and garage, on President Ave., here. Estimated cost, $100,000.

Mass., Holyoke—The Valley Paper Co., 2nd Level Canal, has awarded the contract for the construction of a 1 and 2 story, 50 x 350 ft. factory. Estimated cost, $70,000.

Mass., Jamaica Plain (Boston P. O.)—The Clifton Manufacturing Co., 65 Brookside Ave., manufacturer of rubber goods, has awarded the contract for the construction of a 2 story, 36 x 112 ft. factory. Estimated cost, $40,000.

Mass., North Adams—The Arnold Print Co. will build a 1 story, 80 x 95 ft. addition to its dye house. Estimated cost, $50,000.

Mass., Spencer—The Bigwood Woolen Co., Valley St., manufacturer of woolen goods, has awarded the contract for the construction of a 2 story, 57 x 84 ft. mill. Estimated cost, $25,000.

Mass., Three Rivers—The Otis Co., 4 South St., Ware, manufacturer of cotton, has awarded the contract for the construction of a 5 story, 63 x 270 ft. repair shop and a 2 story, 101 x 912 ft. dye building, at Palmer Mills here. Estimated cost, $400,000.

Mass., Worcester—Anderson & Patterson, Church St., have awarded the contract for the construction of a 1 story, 65 x 75 ft. garage on Franklin St. Estimated cost, $16,000.

Mass., Worcester—The Taxicab Service Co., 353 Pleasant St., has awarded the contract for the construction of a 1 story, 60 x 93 ft. garage. Estimated cost, $25,000.

R. I., Providence—The General Baking Co., 207 Brook St., has awarded the contract for the construction of a 2 story, 95 x 115 ft. addition to its bakery on John and William St. Estimated cost, $150,000.

R. I., Providence—The International Braid Co., Charles St., has awarded the contract for the construction of a 2 story, 28 x 60 ft. addition to its mill. Estimated cost, $25,000.

R. I., Riverpoint—H. T. White has awarded the contract for the erection of a 2 story, 60 x 120 ft. mill, at Pastime Park, for the manufacture of lace.

R. I., Shannock—The Columbia Narrow Fabric Co., plans to build an addition to its mill. Estimated cost, $50,000.

MIDDLE ATLANTIC STATES

N. Y., New York (Borough of Bronx)—The Advance Novelty Candy Manufacturing Co., 511 East 72nd St., is having plans prepared by Haven & Crosby, Arch., 220 Devonshire St., for a 5 story, 100 x 225 ft. factory, to be erected at 138th St. and Willow Ave. Estimated cost, $500,000.

N. Y., Schenectady—The Superior Printing and Box Co., Clinton St., is having plans prepared by J. Densham. Archt., 712 Campbell Ave., for the erection of a 2 story, 30 x 166 ft. factory. Estimated cost, $35,000.

Penn., Altoona—E. A. Caum, 504 9th St., plans to build a 3 story, 75 x 120 ft. ice cream plant and garage on 9th Ave. and 11th St. Estimated cost, $75,000.

Penn., Manayunk (Philadelphia P.O.)—The Philadelphia Paper Manufacturing Co., River Rd., has awarded the contract for the construction of a 2 story, 60 x 200 ft. factory, on Nixon St. Estimated cost, $72,000.

Penn., Philadelphia—The Concordia Silk Hosiery Co., Fishers Lane and Wyoming St., has awarded the contract for the construction of a 2 story, 45 x 125 ft. factory addition on Arch and Courtland St. Estimated cost, $25,000.

Penn., Philadelphia—W. H. and H. E. Margerison, Huntington and Jasper St., will soon award the contract for the construction of a 5 story, 49 x 100 ft. factory for the manufacture of towels. Simon & Simon, 249 South Juniper St., Arch.

Penn., Philadelphia—The J. H. Meyer Cotton Duck Co., Lewis and Ashland St., has awarded the contract for the construction of a 1 story, 46 x 67 ft. and 35 x 125 ft. addition to its factory. Estimated cost, $15,000.

Penn., Philadelphia—M. Sarfet, Kensington and North St., manufacturer of hosiery, has awarded the contract for the construction of a 2 story, 50 x 327 ft. factory.

MIDDLE WEST

Ohio, Cincinnati—The Ruehlmann Flour Co., West 6th St., has awarded the contract for the construction of an 84 x 135 ft. flour mill. Estimated cost, $50,000.

Ohio, Cleveland—The Mid West Box Co., West 106th St. and Western Ave., has awarded the contract for the construction of a 2 story, 100 x 405 ft. factory. Estimated cost, $300,000. K. I. Herman, Gen. Mgr.

Ohio, Dayton—The Burkam Herrick Publishing Co., South Jefferson St., plans to build a 4 story, 100 x 190 ft. newspaper plant on 4th St. Estimated cost, $200,000.

Ohio, Dayton—Crawford McGregor & Canby, Albany St., manufacturer of golf balls, have awarded the contract for the construction of a 1 story, 75 x 130 ft. factory. Estimated cost, $25,000.

Ohio, Dayton—The Gem City Ice Cream Co., 1005 West 3rd St., has awarded the contract for the construction of a 3 story, 55 x 60 ft. factory. Estimated cost, $40,000.

Ohio, Dayton—The Miami Ice Delivery Co., Ludlow Bldg., plans to build a 2 story factory on 3rd St., for the manufacture of ice. Estimated cost, $100,000.

Wis., Milwaukee—The O. C. Hansen Manufacturing Co., 291 Milwaukee St., manufacturer of gloves, has awarded the contract for the construction of a 6 story, 60 x 75 ft. and 60 x 260 ft. factory on 6th and Wright St. Estimated cost, $300,000.

Wis., Milwaukee—The Manufacturers Box Co., 130 Reservoir Ave., manufacturers of paper boxes, has awarded the contract for the construction of a 1 story, 100 x 300 ft. factory, on Keefe Ave. and Bremen St. Estimated cost, $100,000.

Wis., Milwaukee—The National Knitting Co., 905 Clinton St., has awarded the contract for the construction of a 3 story, 72 x 146 ft. addition to its factory. Estimated cost, $75,000.

Wis., Milwaukee—The Phoenix Knitting Co., 208 Broadway, is having plans prepared by O. C. Vehling, Archt., 425 East Water St., for the erection of a 7 story addition to its factory.

Wis., Sauk City—J. Dresen and A. Tews plan to build a 2 story, 40 x 210 ft. milk plant, on Main St. Estimated cost, $25,000.

Wis., Sheboygan—The Badger State Tanning Co., South Water St. and Maryland Ave., plans to build a 3 story, 60 x 250 ft. tannery. Estimated cost, $50,000.

Wis., Sheboygan—The Excelsior Wrapping Co., 1635 Erie Ave., has purchased a site and plans to build a 3 story, 60 x 290 ft. factory. Estimated cost, $30,000.

Wis., Sparta—The Interstate Milk Products Co. will build a 3 story, 54 x 78 ft. condensory on Main St. Estimated cost, $75,000.

Wis., Superior—The Farmers' Co-operative Creamery Co. has awarded the contract for the erection of a 1 story, 46 x 112 ft. creamery. Estimated cost, $14,800.

Wis., Tomah—The Tomah Rubber Works, 176 16th St., Milwaukee, will soon award the contract for the construction of a 2 story, 96 x 100 ft. factory, here. Estimated cost, $45,000. L. Hofmeister, Pres.

Wis., West Allis—The Marks Bros. Co., 613 73rd Ave., has awarded the contract for a 2 story, 70 x 100 ft. planing mill, to be erected on 75th Ave. Estimated cost, $30,000.

WEST OF THE MISSISSIPPI

Ark., Arkansas City—G. A. Shryock, 306 East Douglas Ave., Wichita, has awarded the contract for the construction of a 1 story, gasoline extraction plant. Estimated cost, $60,000.

Kan., Wichita—The Bemis Bros. Bag Co., 601 South 4th St., plans to build a 3 story, 130 x 300 ft. factory. Estimated cost, $500,000.

Minn., Minneapolis—The Northern Bag Co., 101-3rd Ave., S., has awarded the contract for the construction of a 6 story, 150 x 300 ft. factory, on Washington Ave., N. Estimated cost, $600,000.

Minn., St. Paul—The Western Chemical Co., 443 South Dearborn St., Chicago, Ill., has purchased a site on 30th St. and University Ave., here, and plans to build a factory and office. Estimated cost, $100,000.

Mo., St. Joseph—The St. Joseph Public Elevator Co., Corby Bldg., has awarded the contract for the construction of a 60 x 90 ft. factory, 184 ft. high. Estimated cost, $225,000.

Neb., Omaha—Farrell & Co., 10th and Dodge St., has awarded the contract for the construction of a 6 story, 60 x 106 ft. factory on 9th and Dodge St., for the manufacture of syrup. Estimated cost, $200,000. Noted Apr. 17.

WESTERN STATES

Ore., Sumner—E. J. Harrington, Seattle, Wash., has purchased the old antimony plant here, and plans to convert same into a woodworking factory. Estimated cost, $5000.

Wash., Montesano—The Schafer Bros. Logging Co. plans to build a 2 story shingle mill. Estimated cost, $5000.

Wash., Seattle—The Cat-of-Nine-Tails Co., East 38th St. and 12th Ave., plans to build a 1 story, 50 x 100 ft. woodworking plant. Estimated cost, $6000. Connichsen & Ginnold, Boston Blk., arch.

CANADA

B. C., Vancouver—The British Columbia Fir and Cedar Lumber Co., foot of Laurell St., plans to rebuild its saw mill. Estimated cost, $250,000.

Ont., Toronto—Blackford, Davies & Co., 60 Front St., W., have purchased a site at 48 Bay St. and plan to build a 10 story, 40 x 150 ft. store and factory, for the manufacture of shoes. Estimated cost, $200,000.

Ont., Toronto—The Cowan Co., Ltd., 72 Sterling Rd., has awarded the contract for the erection of a 5 story, 82 x 250 ft. factory, for the manufacture of chocolate and cocoa. Estimated cost, $450,000. Noted June 5.

Ont., Windsor—The British-American Brewery Co., Pitt and Bruce Sts., has awarded the contract for the erection of a 3 story, 40 x 80 ft. brewery. Estimated cost, $32,000.

Que., Montreal—The Alaska Feather and Down Co., 300 St. Ambrose St., has awarded the contract for the construction of a 3 story, 80 x 280 ft. factory. Estimated cost, $200,000.

Que., Montreal—The Frontenac Brewery, Ltd., St. Lawrence Blvd., will build a 3 story, 40 x 50 ft. brewery, on De Gaspe St. Estimated cost, $10,000.

Que., Montreal—The Guaranteed Pure Milk Co., St. Catherine St., W., has awarded the contract for the erection of a 3 story, 48 x 50 ft. plant. Estimated cost, $19,000.

Que., Montreal—A. Lafrance, 707 Lafontaine St., will build a 3 story, 40 x 80 ft. woodworking plant. Estimated cost, $30,000.

Que., Quebec—The J. Ritchie Co., Ltd., 39 St. Helene St., manufacturer of shoes, is having plans prepared for the erection of a 3 story, 50 x 75 ft. factory. Estimated cost, $35,000.

Que., Sherbrooke—J. Kayser & Co., Frontenac St., manufacturer of gloves, have awarded the contract for a 4 story, 100 x 300 ft. factory, to be erected on Notre Dame St. Estimated cost, $250,000. Noted June 5.

Que., Three Rivers—J. B. Belleview, 74 Dufleuve St., will build a 3 story, 48 x 62 ft. factory, for the manufacture of dry goods. Estimated cost, $7000.

Que., Three Rivers—The International Paper Co., 30 Broad St., New York City, will build 2 story mills to cover a 100-acre site, here. Estimated cost, $3,000,000. Noted Mar. 27.

Que., Three Rivers—The Lava Cement Clay Products Co. will build a plant on Madeline St., to consist of several buildings. Estimated cost, $100,000.

Machine Tools Wanted

The following concerns are in the market for machinery and machine tools:

Md., Baltimore—The Howell Motor Car Co., Mt. Royal Ave. and Catherine St.—automobile repair tools.

N. Y., Buffalo—The Curtiss Aeroplane and Motor Corporation, 1972 Cutiss Ave.—12 to 18 in. upright gear hobber. (new).

N. Y., Gloversville—The Reliable Mill Supply Co.—16 to 20 ft. bed planer, (used) and a 10 in. dividing shear with tail center, (new or used).

N. Y., New York (Borough of Manhattan)—The Crowninshield Shipbuilding Corporation, 91 William St.,—vertical shear to cut 1 in. material, 3 in. horizontal angle punch and plate bending rolls.

Penn., Bloomsburg—C. Housnick, c/o W. H. Lee, Arch., 30 South 17th St.—pumps and tanks.

Penn., New Castle—The South Side Garage Co., Phillips and Mill St.—Motor driven, fully equipped lathes, 14 in. to 8 ft.

Penn., Philadelphia—J. F. Arlong, 9th and Green St.,—pumps and tanks.

Penn., Philadelphia—The Bigelow Willey Motor Co., 304 North Broad St.—pumps and tanks.

Penn., Philadelphia—The E. G. Budd Manufacturing Co., 25th and Hunting St.—machine tools.

Penn., Philadelphia—M. E. Hecht, Empire Bldg.,—pumps and tanks.

Penn., Philadelphia—J. Woldow, c/o J. E. Feldstein, Arch., Penfield Bldg.,—pumps and tanks.

Penn., Pittsburgh—The Tranter Manufacturing Co., 105 Water St.—2 upright presses, (new or used) and a vertical miller for die work, 14 or 16 in. table travel. (used).

Penn., Pottsgrove—L. M. Moll—engine lathe, (used).

Tenn., Knoxville—The Standard Knitting Mills, Washington and Mitchell St.— metal lathes.

W. Va., Huntington—G. N. Stoody & Sons—power punch, metal rolls and shears for sheet metal work in boiler making, and a pipe threading machine up to 8 in. capacity, and a 24 in. lathe, used.

Ill., Chicago—The E. L. Easley Machinery Co., 555 West Washington Blvd.,—No. 70 old style Heald internal grinding machine. (new or used).

Ill., Chicago—The Wilson & Bennett Manufacturing Co., 4532 South Menard St.—open back inclinable press, 14 in. back, 3 in. stroke. (new or used).

Ind., Marion—The Indiana Truck Corporation,—No. 4B. 6 in. Capitol Cockrane Bldg. metal sawing machine, (new).

Mich., Detroit—M. A. Young, 924 Woodward Ave.,—complete machine equipment for making repairs to automobile trucks, washing racks, and complete outfit for refinishing automobiles.

Ohio, Barberton—The Columbia Chemical Co., Columbia St.—50 in. gap lathe 20 ft. between centers, fully equipped, a grinding machine, either 12 x 40 in. or 12 x 60 in., a lever feed drill press to drill to center of 20 in. circle and a radial drill with same capacity power feed.

Ohio, Cambridge—The Cambridge Foundry and Machine Co.,—20 in. geared drill press and a four spindle automatic screw machine, (used).

Ohio, Canton—The Timken Roller Bearing Co., Dueher Ave.,—24 in. slotter, and a 48 in. lathe, 14 ft. bed.

Ohio, Cleveland—The Chain Products Co., 2900 Cooper Ave.—several profilers and can cutting machines.

Ohio, Cleveland—The Cleveland Graphite Bronz Co.—open back inclinable power press.

Ohio, Cleveland—The Crescent Brass Manufacturing Co., 8410 Lake Ave.—turret lathe, (used).

Ohio, Cleveland—The Dill Manufacturing Co., 694 East 82nd St.—3 metal stamping presses.

Ohio, Cleveland—The Marsh Motor Car Co., 1003 American Trust Bldg.—30 hp. slide valve steam enyine. (new or used).

Ohio, Lakewood (Cleveland P. O.)—Bd. Educ., Citizens Bank Bldg., P. T. Harrold, Clk.—woodturning machinery, lathes, saw and presses.

Ohio, Sandusky—The Farrell-Cheek Steel Foundry Co., 1st St.—48 in. vertical boring mill.

Wis., Milwaukee—The Bankers Automatic Alarm Co., c/o I. Gascula, 836 1st Wisconsin National Bank Bldg.—lathes, grinders, drill presses, punches, etc.

Wis., Milwaukee—The Milwaukee Forge and Machine Co., 340 Oklahoma Ave.—lathes, drills and small bench tools.

Wis., Tomah—The Tomah Rubber Works, 176 16th St., Milwaukee—mill machinery to manufacture inner tubes for automobile tires.

Minn., Duluth—The A. Guthrie Co., 366 Jackson St., a single end punch shear, 36 in. throat, to take ½ to 1 in. through 1 in. material.

Mo., St. Charles—C. P. Maloney, 7th and Olive St.—drills, presses, lathes, cutters, screw machines and miscellaneous equipment.

Mo., St. Charles—The St. Mary's Oil Engine Co.—14 ft. x 48 in. x 48 in. slab milling machine with four heads. (used).

Mo., St. Louis—J. B. Counts, Pres. of the Counts Soap Co., 5236 North Market St.—1 grease container, 1500 gal. capacity, 3 sets acetylene welding outfits, 1 punch press, 23 thermometers and 6 or 7 electric trucks.

Mo., St. Louis—The General Machinery Manufacturing Co., 920 North Main St.—thread miller for making elevator worms.

Mo., St. Louis—W. Lesselg, acting purchasing Agent for the Rowan Electric Manufacturing Co., 713 Star Bldg.—Eleven 10 x 26 lathes; Four No. 4 plain millers; One small speed lathe; Six bench drills; One geared head turret lathe; One or more 1 in. bolt cutters; One 12 in. shaper, hangers, small engines, belts, pulleys conveyors, etc.

Mo., St. Louis—The Mund Tool Co., 1203 South 7th St.—40 and 60 lb. cushioned helve hammers. (new or used).

Que., Montreal—The G. F. Foso Machinery and Supply Co., 305 James St.—7 ft. plain radial drill and a 6 in. bar. floor boring, drilling and milling machine. (new).

Chili, Tang-Ku—The Ung-Lee Soda Co., Limited—20-in. back geared crank shaper, 16 in x 6 ft. high duty engine lathe an 84 in. vertical boring mill and a 7 ft. wall radial drill.